RUTGERS
New Jersey Agricultural Experiment Station

NEW JERSEY
DEPARTMENT OF AGRICULTURE

Proceedings
of the
2024 New Jersey Annual Vegetable Meeting

February 6, 7, & 8, 2024

Harrah's Resort and Convention Center
777 Harrah's Blvd., Atlantic City, NJ

Sponsored by:

Vegetable Growers Association of New Jersey, Inc.

In conjunction with:

Rutgers New Jersey Agricultural Experiment Station

and

The New Jersey Department of Agriculture

Proceedings Compiled By:

Meredith Melendez
Agricultural Agent
Rutgers Cooperative Extension Of Mercer County
1440 Parkside Avenue
Ewing, NJ 08638

Rutgers NJAES Cooperative Extension

New Jersey Vegetable Growers Association

Mid-Atlantic Commercial Vegetable Guide

Soil Health

IT ALL STARTS WITH THE SOIL!

Stephanie Murphy, Ph.D.
Director, Rutgers Soil Testing Laboratory
Rutgers University/NJAES
57 US Highway 1
New Brunswick, NJ 08901
slmurphy@njaes.rutgers.edu
https://njaes.rutgers.edu/soil-testing-lab/

In recent years, soil has enjoyed much attention in popular media and the general public as concerns about soil degradation and climate change sharpen society's focus on the need for mitigation, regeneration, and sustainable agricultural practices. Wise and experienced farmers, agronomists, and agricultural researchers have always been alert to the condition and care of soil, and this new consideration has generated efforts to define and refine the practices of caring for the soil.

USDA-NRCS defines soil health as the "continued capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans", with an emphasis on diverse, robust, and balanced biological communities, which contribute to soil's functions of nutrient cycling, organic matter mineralization, and pathogen control, for example. In addition to the biological aspect, evaluation of soil health also considers chemical factors, such as acidity (pH), nutrient availability, and levels of potential contaminants. Physical features are often more difficult to quantify in relation to soil health, but bulk density and porosity characteristics that determine water-holding capacity, drainage, aeration, and root accessibility are critically important for the overall functioning of soil in natural and agricultural roles.
In an agricultural setting, plant yield has often been used as the ultimate measure of soil quality, and yet the input of effort and amendments needed to produce the crops should be taken into account as well. Agricultural sustainability goals require minimizing import of resources to the farm while maintaining or improving production, and this can only be achieved by informed stewardship of the landbase, soil.

Disregard of the importance of soil health has led to soil degradation in many forms. Excessive or aggressive use of tillage leads to breakdown of soil structure, which in turn affects susceptibility to compaction, sealing, erosion, poor drainage, and lack of rootzone aeration. Tillage also disturbs the biological community in the soil and hastens decomposition of organic matter, a key soil health indicator. When soil is left bare, the sustenance that soil organisms gain from photosynthesizing plants and their root exudates is lacking, leftover nutrients in the soil are wasted and lost, and the surface is exposed to erosive forces.

Balanced availability of water and air at the root surface is another function of healthy soil. A combination of micropores and macropores allows both storage of plant-available water and drainage of excess water. This also lets diffusion of gases into and out of the soil, allowing it – and roots and other aerobic organisms in it - to "breathe". Dense, compacted soil, in contrast, has had macropores destroyed, preventing drainage and aeration as well as limiting root growth, causing stress symptoms and yield reductions.

With improved plant cultivars producing greater yields come greater requirement for nutrient “mining” from the soil. This requirement is often achieved with increased input of fertilizers, which decreases the sustainability calculation for the farm, but the side effects of the fertilizer input should be considered as well – how does it affect the biology and the chemistry of the soil? Fertilizers that release high concentrations of ions will certainly harm some organisms and possibly favor ones that are more tolerant. Certain nutrient ions initiate processes that affect the pH of the soil. And nutrients added but not utilized by plants are subject to loss to air or water, not only representing a waste and low nutrient-use efficiency, but also contributing to environmental problems. Soil organic matter is recognized not only as a key indicator of soil health, but also as sequestration potential for carbon after plants incorporate carbon dioxide from the atmosphere into their structural and metabolic organic molecules. Plant and other organic residues are largely decomposed over time, but the highly recalcitrant humus fraction of soil organic matter remaining is important for soil structure, long-term fertility, water-holding capacity, and sustaining certain microbe classes. That stabilized fraction of organic matter – though a small percentage of soil mass - equates to great volumes/mass of atmospheric carbon dioxide, when summed over the soil profiles of large acreages of land. Therefore, restoring organic matter to its natural humus level - or better - not only works to improve soil health but also mitigates the elevated level of atmospheric carbon dioxide that is well understood to contribute to climate warming. The recommended practices for enhancing and protecting soil health include: Maximize Presence of Living Roots, Minimize Disturbance, Maximize Soil Cover, and Maximize Biodiversity (NRCS). Incorporating perennial or cover crops into field plans achieves several of these practices. To address the disturbance issue, reduce the occurrence and aggressiveness of tillage and avoid soil compaction. Greater biodiversity can be achieved with appropriate blends of cover crops, rotation of crops, intercropping, and inclusion of grazing livestock where possible, for example.

Changing long-established practices can be challenging and perceived as risky. The changes can also incur additional costs that would cut into a farm’s financial balance. Potential rewards of management changes may not be observed or measurable for several years. To ease the transition, both in terms of risk and cost, it is recommended to start with small changes to limited areas, and then add more practices and expand the affected area gradually as experience and opportunities allow. Look to NRCS or State resources for financial and technical assistance. Regardless of the current status of your soils, using this guidance will help preserve this valuable natural resource for long-term production of agricultural goods.

ASSESSING SOIL HEALTH IN THE FIELD

Eileen Miller
Soil Health Specialist
Healthy Landscapes Inc.
98 Tuckahoe Road, Dorothy, NJ 08317
healthylandscapesnj@gmail.com

This presentation is intended for individuals who wish to improve or support the health of their soil by gaining understanding of ecological principles that create healthy soil. We will explore and identify common soil constraints by looking at in-field parameters to access soil function and health. We will utilize the USDA NRCS Soil Quality Test kit protocols in our analysis to gain meaningful insight into the soil beneath our feet.

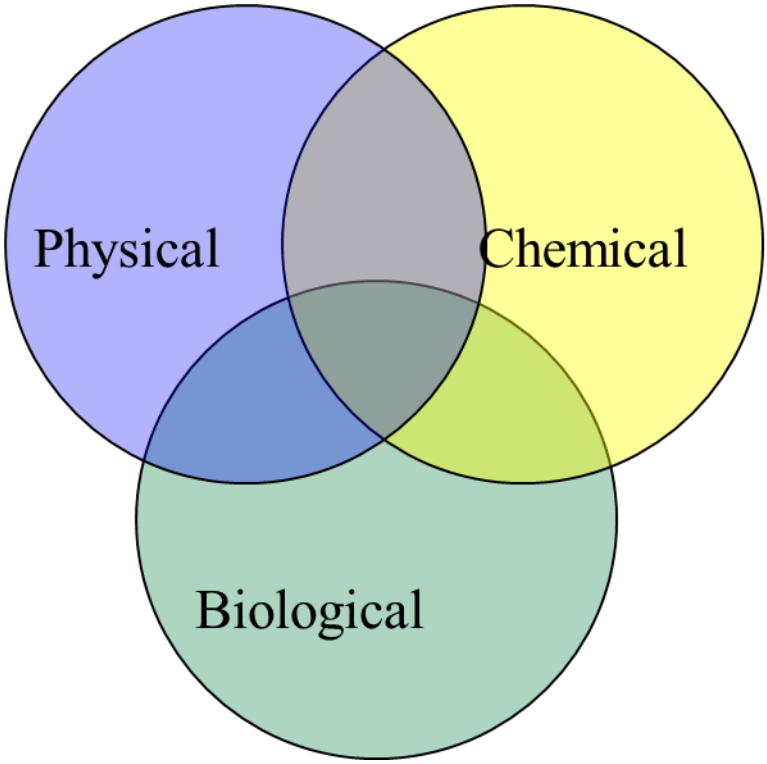
Soil health is defined "as *the continued capacity of soil to function as a vital, living ecosystem that sustains plants, animals, and humans."* It cannot be determined by measuring just one thing, such as crop yield, bulk density, water quality or any other single outcome. It is created by the combination of parameters, which create a synergistic effect on the soil ecosystem. Indicators are measurable properties that can provide insight into soil function and future agronomic success.

Healthy soil purifies air and water by performing five essential functions that are integral to evaluating the performance of a soil for a selected purpose.

1. Healthy soil regulates and partitions water and solute flow.
2. Healthy soil sustains biological diversity of plant and animal life above and below ground.
3. Healthy soil filter, buffer and degrade pollutants.
4. Healthy soil cycle and store carbon and other nutrients.
5. Healthy soil gives physical stability and support to plants.

Healthy soil is the goal of any successful agricultural operation, whether it be a large commercial farm, a small backyard garden, or an urban garden using containers. The principles that we use to assess Soil Health apply to a variety of land uses.

Inherent and dynamic soil properties help us evaluate the capacity of a soil to function and serve as useful indicators for overall Soil health. Inherent (or use invariant) soil properties refer to what the soil was "born with" as far as geology, climate, biota, topography, parent material and drainage class is concerned. These properties form over thousands of years through soil formation and are indicative of type of clay, depth to bedrock and drainage class of a particular soil. These properties are not easily changed by human management. Dynamic properties (or use dependent) are affected by human management systems and natural disturbances over the human time scale. Dynamic changes are ones that we can have a degree of control over, through the use and management of our resources. Dynamic changes often occur quickly, over a single growing season or may need more time to rebound. There are many dynamic soil health indicators, and we will explore the most common ones to gain a better understanding of how they influence Soil Health.



Soil Health indicators are divided into the Physical, Chemical and Biological aspects of the soil and relate to how each aspect influences soil function.

Physical indicators relate to soil texture, structure, color and bulk density. They affect the physical support of plants, aeration, soil and water storage, erosion resistance, root proliferation and organism movement. **Chemical indicators** relate to nutrient storage and release, soil chemical reactions and carbon storage. **Biological indicators** relate to pest suppression, nitrogen mineralization, organic matter decomposition and microbial community interactions.

As we explore and discuss the importance of each indicator, we will learn how to create Soil Health Management Systems that improve soil function. This can be achieved by maximizing living roots in the soil, minimizing disturbance and tillage, maintaining living cover throughout the year, and maximizing diversity of plants and soil microbes.

Mineral Nutrition and Plant Health

Joseph Heckman
Extension Specialist Soil Fertility
Rutgers University
59 Dudley Rd
New Brunswick, NJ 08901

Plant growth and nutrition requires access to eighteen essential elements, most of them taken up from soil as minerals. An element is classified as essential when it is critical to reproduction and completion of the plant life cycle. Several more elements which are not classified as essential, are referred to as beneficial substances for plants.

Soil fertility and plant nutrition is concerned with the art and science of providing mineral nutrients at optimal rates and balance for economic crop yield and plant health. Often there is more focus on crop yield than on optimizing plant mineral nutrition for prevention of plant disease. Also, there tends to be more attention given to using agricultural chemicals, such as fungicides, to protect plants from disease than managing mineral nutrition to support crop health.

The 2023 publication of *Mineral Nutrition and Plant Disease* by the American Society of Phytopathology is an opportunity to refocus attention of how mineral nutrients can be used to protect plant health. This presentation for the New Jersey Commercial Agricultural Convention Education Program will explain ways to use the wealth of information in the 2nd edition of this bestselling book to improve plant nutrition and offset the frequent use of pesticides.

By far N is the most influential nutrient for plant disease management. The supply of N, either by deficiency or excess, is often a significant factor in susceptibility to plant disease. Thus, predicting the correct application rate for N can help to minimize disease. But beyond N supply another very important aspect of N nutrition is fertilizer source. The chemical form N, ammonium or nitrate can have a major influence on susceptibility to disease. Some crops have a strong preference for ammonium-N while others prefer nitrate-N, and some crops perform best with a mix of ammonium and nitrate.

Ammonium sources cause acidification of the bulk soil as well as the soil near the surface of roots. Nitrate sources tend to cause an increase in soil pH near the surface of plant roots. Such changes in soil pH can influence micronutrient availability which then impacts plant vulnerability to disease. To give an example, using ammonium type fertilizers such as ammonium sulfate can enhance manganese (Mn) availability which then helps to suppress certain plant diseases such as take-all of wheat.

After careful consideration of N supply and source, the management of other nutrients will each be considered for how they interact and factor into plant health.

Specialty and Niche Crops

HABANERO PEPPERS IN CENTRAL NEW JERSEY: MARKET OPPORTUNITIES

Albert Ayeni, Ph.D.
Retired Ethnic Crop Research Specialist
59 New Road, Kendall Park NJ 08824
+1-856-279-8641; aayeni192@gmail.com

Introduction: Habanero peppers (*Capsicum chinense*) are known for their high dietary fiber, and vitamins A and C. They are rich in flavor (1). The heat principle in the fruit, which is dictated by the capsaicin content, varies widely among varieties, and ranges from <50K for the Pumpkin Habanero to over 2.6 million Scoville Heat Units (SHU) in Pepper X (2). This wide range in heat level serves a diverse human population, with each culture developing a taste for heat that suits the traditional heat tolerance level of the community. The global market value for the habanero peppers was US$5.93 billion in 2022 with Spain and Mexico ranked top on the list of exporting countries and the United States ranked the top importer (3). Most of the produced habanero peppers go into the fresh market, while increasing percentages are now entering the hot sauce, dried fruit, and pepper powder markets. Data are scarce on the relative composition of the different use segments in the global market, including medicinal, pharmaceutical, and cosmetic applications. With this versatile utilization potential and an array of studies that have confirmed crop adaptability to New Jersey and the mid-Atlantic ecosystems (1), habanero peppers have a bright future in our region's agriculture. This report discusses market studies done between 2021 and 2023 on the market opportunities that need to be explored for greater farm profitability for our growers in New Jersey and the mid-Atlantic.

Methodologies and Results: In New Jersey, the increasing population diversity presents expanding opportunities for habanero peppers. This report describes the trend in the habanero market in Central New Jersey between 2021 and 2023. Central New Jersey in this report refers to Middlesex (North Brunswick and New Brunswick), Somerset (Hillsborough) and Essex (Orange) counties. Between 2021 and 2023, studies were carried out to determine current interest in habanero peppers in ethnic supermarkets. The number of participating supermarkets in the purchase of habanero peppers for retail sales increased from 2 in 2021 to 6 in 2023 and the total fruit weight purchased increased from 391lb in 2021 to 686lb in 2023 (Table 1). The active sales period for the habanero peppers fell between September and October each year and

Regular habaneros Superhot habanero

the primary source of supply was from Specca Farms Pick-Your-Own in Bordentown, New Jersey. Some of the regular habaneros (30-350K SHU) and superhot habaneros (> 1 million SHU) used in these studies are shown in Figure1.

Year	Total wt. (lb) of purchased habanero fruit		# Participating Supermarkets	Remarks
	Regular hab	Superhot hab		
2021	322 @$2.5/lb	69 @$5/lb	2	Regular habs and superhots shared between hot sauce and fresh markets
2022	471 @$3.5/lb	132 @$5/lb	3	Regular habs and superhots shared between hot sauce and fresh markets
2023	626 @2.50/lb	60* @$4.5/lb	6	Regular habs and superhots taken by the fresh market only

Figure 1. Regular and Superhot habanero peppers used in these studies (Photos: Albert Ayeni)

Table 1: Market data for regular and superhot habanero peppers in Central NJ between 2021 and 2023 (Source: Studies conducted in collaboration with supermarkets in Middlesex, Somerset and Essex Counties, Central New Jersey)

**Superhot habaneros were in short supply in 2023, the reduced purchased volume did not reflect a decline in customer demand.*

This study showed a steady increase in customer interest for habanero peppers. Each participating supermarket preferred habaneros based on consumer preferences as described below:

Indian supermarkets: prefer the red and mild, small to medium size habaneros such as the Red Pumpkin Habanero types. They will also consider the yellow habanero such as the Yellow Pumpkin Habanero in the absence of the red type. Some of the supermarkets prefer to mix the fruit colors and allow the customers to decide which one to choose. Large size habanero peppers are not attractive to some of the supermarkets. To such supermarkets, the large fruit size portrays little to no flavor, while the small/medium bright red/yellow fruit signifies strong flavor and better taste. Superhot habaneros are too hot for the Indian supermarkets.

Hispanic supermarkets: will accept a variety of habanero peppers ranging from mature green to ripe fruit of different colors (red, yellow, brown/chocolate, etc.). They have preference for medium/large fruit and moderate to high heat level (Scotch bonnet heat level is cherished --- 200-350K SHU). The Hispanic supermarkets do not patronize the superhot habaneros.

African supermarkets: prefer the ripe superhot habanero peppers but will consider the red ripe regular habaneros with high heat level. With the superhot habanero, the household needs just a fruit or two to satisfy the family's taste, compared to the regular

habanero where several fruits are needed to provide the needed “kick”. The yellow habaneros will be considered only if there is no choice. To the African supermarkets, the red pepper adds redness to the soup, which reduces the amount of red oil needed to make the soup attractive to the eye. The mature green habanero is generally unacceptable in the African supermarket. It does not add value to the soup.

The hot sauce producers: will accept all types of ripe habanero fruits including the superhots depending on the hot sauce formulation intended. Consistency or uniformity of fruit integrity, color, flavor, and taste is the most desired attribute the hot sauce producer needs. In 2020, Rutgers University Dining Services brought to the market the Scarlet Hot Sauce, which was produced from the Rutgers Rosebell Red habanero released from the Rutgers Exotic Pepper Project and cultivated at Rutgers Horticulture Farm 3. Figure 2 shows the finished Scarlet Hot Sauce on the display shelf for the buyer.

*Figure 2: The Rutgers Scarlet Hot Sauce on the display shelf for the market (*Photo: Rutgers Dining Services*)*

Habanero pepper wholesale price: Between 2021 and 2023 the average price of regular habanero wholesale and delivered to the supermarket was $2.8/lb and $4.8/lb for the superhot habanero (Table 1). The difference between the prices of the habanero types is primarily due to the market supply/demand dynamics and yield potential of the two. The regular habaneros produce much higher yields than the superhots on weight basis. The fruit density of the regular habaneros is much higher than that of the superhots, so for the same weight, one might need to harvest three to four stands of the superhot habanero for the weight of fruit harvested from one stand of the regular habanero. For the foreseeable future this price difference is likely to hold.

Conclusion: The habanero pepper is gaining traction in Central New Jersey. Current demands are mainly in the fresh and hot sauce markets and growing, in line with the growing ethnic populations in New Jersey and the mid-Atlantic region. At >$2/lb for the regular habanero and >$4/lb for the superhot habaneros; and fresh fruit yields that range from 15-20 tons/acre for the regular habaneros and 7-10 tons /acre for the superhot habaneros, these are profitable crops to grow in New Jersey and the mid-Atlantic. Beyond the use for food, habaneros also have significant applications in the health and cosmetic industries, which should further enhance their economic viability in New Jersey and the mid-Atlantic.

Acknowledgment: I am indebted to the Managers of Patel Brothers Farmers Market (North Brunswick) Patidar Supermarket (North Brunswick and Hillsborough), Apna Baza Supermarket (Franklin Park), Fine Fare Supermarket (New Brunswick) and Frednes International Market (Orange) for the cordial collaboration in this study. I also wish to acknowledge the valuable collaboration with Specca Farms Pick-Your-Own in Bordentown, which allowed me to produce the high quality peppers used for these studies.

References:

1. Ayeni, A., Healy, H., Melendez, M., Orton, T., and Simon, J.E., 2017. Ultra Niche Crop Series: Production and Marketing of Habanero Peppers in New Jersey. NJAES Cooperative Extension Fact Sheet # 1273 https://njaes.rutgers.edu/fs1273/
2. Pappas, S. 2023: How Hot Is ‘Pepper X’? Its Creator Spent 6 Hours Recovering from Eating It. Scientific American https://www.scientificamerican.com/article/what-makes-pepper-x-so-hot/
3. [Tridge] 2022. Overview of Global Habanero Market https://www.tridge.com/intelligences/habanero

Hemp

CURRENT HEMP MARKET TRENDS

Stephen Komar[1] and Bill Bamka[2]
Rutgers Cooperative Extension of Sussex County
130 Morris Turnpike, Newton, NJ 07860[1]Rutgers Cooperative Extension of Burlington County 2 Academy Drive
Westampton, NJ 08060[2]
komar@njaes.rutgers.edu
bamka@njaes.rutgers.edu

There is renewed interest from producers related to the feasibility of hemp production in New Jersey as it is grown for a wide variety of consumer and industrial products. Industrial hemp may represent a new crop and market opportunity for New Jersey farmers. Additionally, industrial hemp may fit nicely with existing crop rotation practices with other field crops. Although there is much interest and speculation related to hemp production, there has been limited research conducted in the northeastern United States and none in New Jersey to quantify the economic feasibility of hemp production. Industrial hemp is a very versatile crop with many uses and production systems including CBD, oil, seed and fiber. Each end-use requires specific production systems, agronomic practices, crop management, and post-harvest concerns. Industrial hemp producers should carefully identify which industrial hemp product(s) they intend to produce and develop an in-depth production and marketing plan. The difficulty in finding current market information including commodity price and consumer demand makes developing accurate business and marketing plans difficult.

Today the hemp industry continues to develop as restrictions on production have been lifted and in response to consumer interest and demand for a diverse pool of hemp products. In general hemp is grown for fiber production, seed production, cannabinoid CBD production, or in some cases as a dual-use crop (often fiber and seed). The uses for hemp products have been reported to consist of more than 25,000 products ranging from textiles to health supplements. In recent years the demand for CBD products has increased dramatically resulting in significant interest from producers in the northeastern United States.

Although there has been anecdotal evidence for the economic viability of hemp as a crop for New Jersey, several potential obstacles exist which must be addressed before the industry is viable. Among these potential obstacles include limited infrastructure, agricultural supply chain concerns, the availability of commercially available planting, harvesting, and processing equipment, limited research on varieties, and limited access to regional production and marketing budgets.

As is the case with any emerging agricultural product, limited data exist to quantify the economic feasibility of industrial hemp production in New Jersey. Although industrial hemp production may provide an opportunity for New Jersey, it is crucial that producers carefully examine the market and accessibility of market channels as part of a marketing plan for their operation.

AGRONOMICS OF FIBER HEMP PRODUCTION IN NJ

Bill Bamka[1] and Stephen Komar[2]
[1]Rutgers Cooperative Extension of Burlington County2 Academy Drive
Westampton, NJ 08060
[2]Rutgers Cooperative Extension of Sussex County
130 Morris Turnpike, Newton, NJ 07860
bamka@njaes.rutgers.edu
komar@njaes.rutgers.edu

The 2014 Farm Bill paved the way for domestic production of hemp (Johnson, 2018). The 2018 Farm Bill directed the United States Department of Agriculture USDA to establish a national regulatory framework for hemp production in the United States. These rules were completed in early 2021 and took effect on March 22, 2021. The New Jersey Hemp Farming Act was enacted in August 2019. This new legislation complies with the 2018 Farm Bill and provides the regulatory process that allows hemp producers to grow and sell hemp for commercial purposes in New Jersey. On December 27, 2019, New Jersey was among the first three states to have its Hemp Program approved by the USDA. These regulations are enforced by the New Jersey Department of Agriculture Hemp Program.

There is renewed interest from producers related to the feasibility of hemp production in New Jersey as it is grown for a wide variety of consumer and industrial products. Industrial hemp may represent a new crop and market opportunity for New Jersey farmers. Additionally, industrial hemp may fit nicely with existing crop rotation practices with other field crops. Although there is much interest and speculation related to hemp production, there has been limited research conducted in the northeastern United States and none in New Jersey to quantify the feasibility of hemp production in the state.

Certain varieties of hemp are grown for their fiber content. Fiber is harvested from the stalks of hemp fiber varieties and consists of long bast fibers (2-25 mm) and shorter hurd fibers. The bast fibers are a higher-quality fiber found in the portion of the stalk. These long fibers are hollow inside and are very strong making them ideal fibers for various products including high quality paper, fabrics and textiles, cordage, insulation, and carpeting. The shorter hurd fibers have a higher lignin content and are woodier than the bast fibers making them ideal for use in the production of materials such as fiberboard, paper additives, animal bedding and as additives in plastics, spill absorbents, mortar and fiber board. Hemp fibers are also being used as components in building materials such as hempcrete and as a replacement for synthetic fiber composite in automobile interiors, making hemp fiber production a potentially environmentally friendly cheaper natural alternative to other fibers.

Fertility Summary:
We have not yet determined optimum fertility rates for hemp grown in NJ. The best information we have currently is from Pennsylvania. Penn State has developed fertilizer recommendations for hemp grown for seed harvest. In a soil with optimum levels of

phosphorus (P) and potassium (K), recommendations for a crop with a 1,500-pound yield potential would be 150 pounds of nitrogen (N), 30 pounds of phosphate (P_2O_5), and 20 pounds of potash (K_2O). Fertility recommendations are slightly different for hemp grown for fiber compared to seed. At optimum P and K soil test levels a recommendation would be 150 pounds of N, 20 pounds of P_2O_5, and 20 pounds of K_2O.

If considering hemp production, keep in mind that there have been very few U.S.-based agronomic research studies on hemp since the early 20th century. Information from previous research is important and useful but may not always be completely applicable for modern production systems. Hemp has been grown as a crop in New Jersey on a limited basis since 2020. Research is needed to provide data on planting, management, fertility, harvesting, and processing specific to New Jersey. As a result, production information gaps may be encountered in the short term.

Hemp cultivation requires significant management, as well as specific field and environmental conditions specific to the type of hemp product being harvested. Hemp production is impacted by seedbed preparation, soil type, day length, seeding rates, seeding dates, row spacing, harvest dates, and soil moisture among other variables. Hemp varieties grown for fiber, oil seed, and CBD have different cultural requirements.

Soil preparation for hemp is similar to other spring crops. Hemp seeds require a firm seedbed and good soil contact to germinate well. Hemp could likely be grown in no-till and reduced-till systems, but this approach is not well-studied. A lack of currently registered herbicides also adds to the uncertainty of using reduced-till systems. Soil temperature, growing season length, and frost danger dictate when to plant hemp.

Variety Selection:
Variety selection will be key to successful production of all hemp types for many reasons; one of the most important varietal traits is days to maturity (latitudinal adaptation). When growing hemp for fiber only production, seeding rate is often double what is used for grain production. Recommended seeding rates range from 40 to 60 lbs. PLS/acre. Significant research is limited regarding seeding rates to achieve high yielding and good quality fiber. Planting too low a plant population will not provide competition for early season weed control. Hemp for fiber is planted in dense stands to promote taller height and discourage branching and flowering, thus maximizing fiber yields. Higher seeding rates encourage a higher quality fiber crop. Good quality hemp fiber comes from tall and thin plants. Higher seeding rates result in high plant population with tall thin plants with longer internodes.

Harvesting fiber crops is more complex than harvesting grain. Fiber crops will require retting prior to baling. Conventional hemp fiber production relies on field drying and straw retting – a process by which microbes degrade the pectin layer between the plant’s bast fibers and woody core. Sufficient moisture assures the microbial degradation processes occur, but dry weather also is required to ensure the hemp stalks can be baled, weather conditions can affect fiber quality. Field retting hemp requires skills similar to producing high-quality hay. Successful field retting will be dependent on weather conditions just as making good hay. Harvesting hemp stems for fiber with standard hay equipment can be difficult. Current common practice involves

mowing by sickle-bar or mower-conditioner without conditioning/macerating, retting in the field, followed by baling. Hemp is swath or windrow cut for fiber production at about 8” from the soil surface, between early bloom and seed set when the lower leaves of female plants begin to yellow.

As we begin to have more experience with hemp production, we are learning that varieties are regionally specific. Farmers looking to enter the hemp market for the first time will need to understand varietal options that are available and carefully determine which hemp variety is most suitable to their production and marketing strategies.

REGULATORY UPDATES ON THE NJ HEMP PROGRAM

John Kerr
Hemp Program Manager
NJDA
P.O. Box 330
Trenton, NJ 08625
John.Kerr@ag.nj.gov
https://www.nj.gov/agriculture/divisions/pi/prog/nj_hemp.html

The 2018 Farm Bill instated the federal legalization of hemp nationwide in the United States. Provisions within the Farm bill removed Hemp from the controlled substances act, and specifically defined Hemp as the following: "*the plant Cannabis sativa L. and any part of that plant, including the seeds thereof, and all derivatives, extracts, cannabinoids, isomers, acids, salts, and salts of isomers, whether growing or not, with a post decarboxylation delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent, or the current federally acceptable hemp THC level, on a dry weight basis. Hemp and hemp-derived cannabinoids, including cannabidiol, shall be considered an agricultural commodity and not a controlled substance due to the presence of hemp or hemp- derived cannabinoids."* Upon the enactment of the 2018 Farm Bill, each state was tasked with curating State Plans for their respective Hemp Programs. States were subsequently allowed to create and enact more restrictions compared to the Federal Farm bill to cater to each State's needs. USDA reviews each state plan and approves or denies their plans accordingly. This is where the New Jersey Hemp Farming Act came into existence.

Sections 1 through 9 of P.L.2019, c.238 (C.4:28-6 et al.), known as the "*New Jersey Hemp Farming Act*" was approved on August 9, 2019. This enactment saw the formation of the New Jersey Hemp Program, with N.J.S.A. 2:25-1 et seq. created to enact the regulation of the state program. Our program has not diverged significantly from the farm bill, with most definitions found in N.J.A.C. 2:25-1.2 referenced directly from the Farm Bill. Some unique qualities of our state plan include pre-planting reports, mid-season vegetative samples, in-house collection for testing, and HPLC as a standard with our SOP. Over the years, our program has needed to adapt to an evolving industry and has helped our growers and processors to the best of our abilities.

The Cannabis Regulators Association (CANNRA) recently spoke at a congressional hearing back in September related to regulation of cannabinoid content found in hemp products. CANNRA is a nonpartisan association of government officials involved in cannabis regulation, with their scope of focus including hemp. This organization was able to compile a large draft letter shedding light on the current loopholes that are currently being manipulated by bad faith individuals. Some of their key points included: (a) Delineation of the definition of hemp fiber and grain from cannabinoid extraction and smokeable products, (b) Amending the definition of hemp to include THCA and to properly define Total THC within the Farm Bill, (c) Define and broaden the limitation of "dry-weight basis" to include final product, (d) Define specific parameters to identify who would be best to regulate hemp products for public health, amongst other challenges

that regulators face. CANNRA is correct that these issues need to be addressed. Many of these nuanced issues become a “hot potato” issue, that gets passed around due to broad definitions found within the Farm Bill. Established regulation would allow larger companies to feel safe in expanding hemp markets, thus boosting the hemp industry overall.

On November 16th, 2023, President Biden signed into law H.R. 6363, the *Further Continuing and Other Extensions Act*, 2024, which extended the Agriculture Improvement Act of 2018 (Farm Bill), more commonly known as the 2018 Farm Bill. This extension allows authorized programs to continue through September 30, 2024. (Website: USDA). During the convention, I had planned on exploring the 2023 Farm Bill and the applied changes to the federal rule, but due to congressional issues, our program will be running on the same 2018 Farm Bill. I plan on reiterating the current Farm Bill and the basic principles that our Program follows based on the 2018 Farm Bill. Due to the extension, States have begun to take matters into their own hands and have enacted laws such as restrictions on synthetic psychoactive cannabinoids. New Jersey has a bill that is currently in committee that has not officially passed as of the submission of this document. These bills are respectively S3944 and A5440, which will prohibit production and sale of products containing Synthetic tetrahydrocannabinols. As mentioned previously, this bill has not been enacted into law, so I cannot discuss the specifics until that has happened. If passed before the AG Convention, I will happily discuss the specifics of the new law.

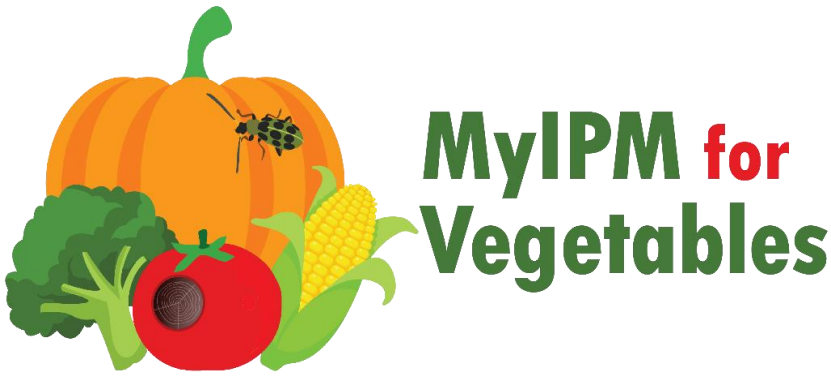
Our Program is currently in the process of amending a few definitions and rules into N.J.A.C. 2:25-1 et seq. for the 2023 cycle. Some of our amendments include the revoking of the pre-planting reporting requirements and mid-season vegetative samples, since they create added confusion to growers for reporting purposes. Our goal in the Hemp Program is for growers to flourish in the hemp industry, and adding excess reporting documents and sampling methods discourages new applicants. Our new reporting documents have been streamlined for ease of access, and especially for submission on smart phones so reports can be submitted in the field! We are looking forward to seeing more interest in the hemp world and hope to diversify our program to cater to all interests!

Vegetable Production I

UPDATE ON MANAGING PESTS IN VEGETABLES

Thomas P. Kuhar[1] and Rebecca A. Melanson[2],
[1]Virginia Tech Dept. of Entomology, 170 Drillfield Drive, Blacksburg, VA 24061-0319
[2] Plant Pathology, Central Mississippi Research and Extension Center
e-mails: tkuhar@vt.edu; rebecca.melanson@msstate.edu

Insect pests including lepidopteran larvae (caterpillars), beetles, aphids, bugs, thrips, and many others can cause serious headaches for vegetable growers who suffer yield and marketability losses due to their feeding injury and/or presence on harvested produce. Insect control is getting challenging as new invasive species have established in the region, resistance to insecticides has developed in some species, and insecticides have become more selective in their pest spectrum in order to reduce non-target impacts. A useful tool has just launched that can help vegetable growers diagnose pest problems and find effective solutions is the **MyIPM App for vegetables**.



Commercial vegetable producers have a new tool to assist with integrated pest management (IPM) of diseases and insects in vegetables. MyIPM for Vegetables is the newest resource in the MyIPM app series (https://myipm.app/) for smartphones and smart devices. It currently includes modules for diseases and insects of cucurbits and tomatoes, and additional vegetable crops are planned to be added in the future. Modules contain images and descriptions of diseases and insects; information on available chemical, biological, and cultural management methods for each disease/insect; and tables of labeled fungicides and insecticides that include active ingredients, product names, FRAC/IRAC codes, efficacy, application rates, preharvest intervals (PHIs), and restricted-entry intervals (REIs). Links to additional resources may also be included.

App content is focused on commercial vegetable production in the southeastern U.S., but users outside the southeastern U.S. and home gardens may also find information in the app useful. The development of MyIPM for Vegetables content was led by vegetable entomology and plant pathology specialists from universities within the southeastern U.S. who are part of the Southeastern Vegetable Extension Workers (SEVEW). The SEVEW are also responsible for the popular Southeast U.S. Vegetable Crop Handbook (www.vegcrophandbook) that has been a key resource for commercial vegetable producers in the southeastern U.S. for over 20 years. Author and image credits for specific disease or insect profiles and pictures are available at http://myipm.app/vegetablte s.

MyIPM for Vegetables is not intended to replace product labels. It is meant to be a tool to help vegetable producers make informed IPM decisions. ***Pesticide users should always read and follow label instructions prior to use.*** Product labels may change. Product rates may differ depending on the site of application (e.g., field or greenhouse) or type of application (e.g., foliar-applied or soil-applied. Check product labels for additional instructions, precautions, and/or restrictions not listed in the app. Also, check the state registration status of products prior to purchase and use; products may not be registered for use in all states.

MyIPM for Vegetables is free to download for Apple (Apple Store) and Android devices (Google Play). Content is downloaded directly to phones/devices; an Internet connection or cellular signal is not required to access content once it is downloaded. Updates, however, do require an Internet connection or cell signal, and notifications will pop up when updates for downloaded modules and the appropriate Internet/cell connection is available.

The MyIPM series began with MyIPM Fruit & Nut that was originally developed by Clemson University in 2012 for peaches and strawberries; the app has since expanded to include other small fruits, tree fruits, and pecans. Other apps in the series include MyIPM Row Crops and MyIPM Hawaii. The Southern Region IPM Center maintains the databases for the MyIPM series apps.

Acknowledgement
This work is partially supported by the Southern IPM Center (Project S23-043) as part of the USDA National Institute of Food and Agriculture Crop Protection and Pest Management Regional Coordination Program (Agreement No. 2022-70006-38002).

Prepared by **Dr. Rebecca A. Melanson**, Associate Extension Professor, Plant Pathology, Central Mississippi Research and Extension Center; **Dr. Thomas Kuhar**, Department of Entomology, Virginia Tech; **Dr. Tom Bilbo**, Coastal Research and Education Center, Clemson University; and **Ms. Inga Meadows**, Department of Entomology and Plant Pathology, North Carolina State University.

GOLD FLECKING IN TOMATO –
COULD THERE BE OTHER CAUSES BESIDES THRIPS?

Gerald Brust
IPM Vegetable Specialist
University of Maryland Extension
2005 Largo Rd Upper Marlboro, MD 20774
jbrust@umd.edu

In the literature there seems to be no simple answer or consensus as to what causes gold flecking (gf) on tomato. I examine the research of 5 studies that were conducted over the last 25 years on gold flecking in tomatoes:

1. Gold fleck and Thrips study by Ghidiu, Hitchner and Funderburk, 2006. Tomato cultivar used: Florida 47. NJ GH study with plants grown in pots-thrips infested plants vs non infested plants. Fruit was stripped off until only 1-4 left on plant, 50 adult and immature thrips were placed on a fruit. Only *Frankliniella occidentalis* Western flower thrips were used. There were no fruit or plant counts for thrips after infestation. Results: 60% of fruit that was infested had gold flecking and none of fruit that was not infested had gf. There were no thrips ovipositioning marks found on tomato fruit. Not all of the fruit was damaged on the infested plants and it took 3 weeks for damage to appear on fruit. Thrips mortality could have been high—numbers were not followed once infested and feeding damage was variable.

2. Gold fleck and mite field study by Meck, Walgenbach and Kennedy, 2012. Field trial conducted in western North Carolina. Crista variety used in study. Tomatoes were transplanted into black plastic with drip irrigation. Plants were staked and tied. Field plot studies consisted of mite infestations of 1, 8, 17, 25 and 50 mites per tomato leaflet plus a non-infested treatment. This was a 3-year study, with two planting times-spring and fall. Mites were counted weekly by examining the terminal leaflet of the 2nd or 3rd most recently mature leaf, there were no fruit counts for mites. When mite counts reached 'infestation levels' treatments were sprayed with a miticide. The percent of tomatoes with gold fleck on six plants/plot were used to determine gf damage levels. It was either a yes or no on damage, either tomato had gf or it did not, nothing on the amount or severity of the gf damage. They also conducted a GH study of 0, 1, 8 and 50 mites confined to a tomato fruit. Results: Not sure how bad gf was on fruit, just that it was there. Half of the trials showed at least 40-60% of the fruit with gf when there were NO MITES present on the plant. Half of the trials showed a good relationship between gf and increasing mite numbers. In GH fruit trials only at 50 mites per fruit was there any significant amount of gold fleck found on fruit.
Mite damage (gf?) showed up on infested GH tomatoes within 3-days of infestation. (Damage appeared more as damaged cells rather than gold flecking).

3. Physiological explanation as to what gold fleck is by Kreij, Janse, Van Goor and Doesburg, 1992. Research was conducted in GH pots looking at calcium and phosphate levels as well as humidity. X-ray diffraction examined the gold flecks to see what they were made of. They examined either high or low levels of humidity in a day-night pattern as well as the Ca/K ratio at 0.2, 0.6, 1.4, 3.4 and 5.0 and also examined 3 levels of phosphate - low, medium, high. They looked at % of gold flecking on fruit and its severity as well as calcium levels in the plant and fruit. Results: As the Ca/K levels increased from 0.2-5.0 so did the % of fruit on a plant with gold fleck as well as the severity of the gold fleck on the fruit. As phosphate levels increased from low to high so did the percentage of fruit on a plant with gold fleck as well as the severity of gold fleck. As humidity levels went from low to high so did gold fleck percentages and severity.

4. What exactly is gold fleck? Results: Granular masses found in cells of gold fleck fruit. These masses were found to be tiny calcium salt crystals that were calcium oxalate dihydrate and monohydrate.

5. Horticulture trials for gold fleck. The following is a summary of the results of 4 different studies that were summarized by M.M. Peet, 2009: i. As temperature increased above 88^{o}F so did the incidence of gf, ii. As the Ca/K ratio increased above 2.5-3 so did gf, iii. As fruit temperature increased above 85^{o}F so did gf, iv. As phosphate levels rose above 4.2 mM so did gf. Calcium levels are the highest in the fruit around the calyx. Gold fleck is seen foremost around the calyx.

My (Gerald Brust, 2014-2018) GH and field studies examined many factors that seem to contribute to gold fleck from the previous studies. These included temperature, humidity, high Ca/K levels, High P levels and the presence of thrips and mites. The following is the summary of these 18-month studies:

The following results demonstrate a greater chance for gold fleck to manifest itself on tomato fruit if:

• Ca in soil: >4,000-5,000 ppm

• P in soil: >300 ppm

• Ca in tissue at fruiting: >5.5%

• P in tissue at fruiting: >1.5%

• Ca/K tissue ratio during fruiting: $\geq$2.5-3.0

• Thrips: $\geq$5 per flower or white flecking on leaves

• Mites: $\geq$100 per leaf or white flecking on leaves

• Temperatures: ≥88-90°F and Dew Points: ≥68-70°F

• Tomato type: Grape>plum>cherry>round

• Variety makes a difference

Practices that will help to alleviate gold flecking include the following:

1. Add KNO3 via drip at fruit set (K decreases the Ca:K ratio, keep ratio below 1.5) and (use of nitrate instead of ammonium decreases gf occurrence).

2. Add Mg (Mg tissue analysis should be 0.5-1.0%).

3. Lower fruit temperature (use a 30% shade over plants).

4. Reduce mite or thrips populations below moderate to high levels (high levels include white feeding flecks on leaves). Low or moderate levels of mites or thrips do not induce greater levels of gold fleck than the control.

In Summary:
Grape tomatoes are especially sensitive to heavy mite feeding, which results in gold flecking. However, a low to moderate amount of mite (or thrips) feeding does not induce gold flecking even in grape tomatoes. Just because you find gold flecking in the field does not mean you have a mite or thrips problem. Probably 65% of the occurrence of gold flecking in mid-Atlantic tomato fields is caused by high temperatures and dew points (this is why we usually see the damage in July and August). The other 35% is caused by either too high a Ca/K ratio in the plant and/or by high levels of mites or thrips. Growers need to check if they have high levels of mites or thrips before spraying, if for no other reason than to find out which pest they have, as the chemical controls will be quite different for the two.

Wine Grapes I

SHOULD YOU BE GROWING GRAPES?
PROS, CONS, AND SITE SELECTION

Gary C. Pavlis
Atlantic County Agricultural Agent
6260 Old Harding Highway
Mays Landing, NJ 08330
pavlis@njaes.rutgers.edu

First, I've got to ask, how much money have you got? There is an old axiom in the wine business that states if you want to make a small fortune in the wine business start with a large fortune. Doesn't sound too promising does it? As a county agricultural agent with Rutgers Cooperative Extension I meet with 6-10 prospective vineyard/winery owners every month and the economics of the business is certainly one of the considerations that must be taken into account. I find that most of these people fall into two categories; farmers that are looking for something to grow that will actually make money and what I call the 9/11 people. Today's farmers must make a decision, grow a profitable crop or sell the land to the developers. The 9/11 people are from all walks of life and since that fateful day have realized that life is precious and working in a job that they hate is a waste of a life, better to grow grapes and make wine.

The first visit I have with prospective growers is usually over lunch. I figure I have to eat lunch anyway and since 2/3 of these people will never start a winery once they hear what is involved I'm not really wasting my time. I usually start the discussion on a positive note. New Jersey is 5th in wine production in the US and 5th in per capita consumption of wine in the US. So we make a lot and we drink a lot. Given this, it is interesting to note that only 1% of the wine we drink is made in New Jersey. That translates into a tremendous marketing potential for New Jersey wines if we can tap into the other 99% of sales, which we are slowly doing. In addition, even in this down economy, wine sales in the US have continued to increase and the number of wineries in New Jersey has steadily increased. Lastly, New Jersey has some of the best sites in the east for quality wine grape production. This is important because to make great wine you need great grapes. Sounds logical but you would be surprised how many people are only concerned with what the wine label will look like, or the tasting room decor. I had one guy who had already bought the cappuccino machine for the tasting room. He didn't really want to talk about the vineyard and what it takes to produce quality grapes. He's long gone now. That's because owning a vineyard and a winery is farming first. If you get all wrapped up in the romance of wine and having your name on the wine bottle, failure is just around the corner.

The next order of business is to talk vineyard establishment, i.e. how much, where, how, and what grapes. It will cost approximately $8,000 to $12,000 per acre to establish an acre of grapes. That includes the plants, the posts and wire, the irrigation, the land prep, etc. Then you'll need a good, narrow tractor, maybe $40,000 for a good one. You'll need a sprayer to control diseases, say $1,000 to $10,000 depending on size and type. And no, we can't grow wine grapes in the Mid-Atlantic States organically. This region gets too much rain during the summer and the fungal disease pressure is just too intense. Rutgers is conducting research to change this but so far it just can't be done. After all this, I usually lose many of the prospective growers. In the past, I would sugar coat all

this but farming grapes is expensive and better to know the facts up front then to loose your shirt later. It has been said that one of the biggest reasons that wineries fail is that they didn't know what they were getting into financially and were under funded.

Now we need to talk site. Where are the grapes and the winery to be? Do you already own the land? Farmers of course already have the land. 9/11 folks usually don't but if they do they ALWAYS tell me how great their soil is. Soil is not the top priority for site selection. First of all, I want to know how cold it gets on their land in the winter. If it gets to -10 degrees Fahrenheit routinely the grapes are going to die. It won't matter that the soil was great. In New Jersey it rarely gets below 0 in Cape May County but routinely gets there in Sussex County. If you want to grow Merlot in Sussex it is not possible. You'll have to grow Concord or the cold hardy varieties from the Minnesota grape breeding program which can withstand -35 degrees F. Matching the site with the grape variety has been the essence of fine wine for thousands of years.

From there we will cover trellis types, fertility, plant spacing, row covers, row orientation (always north/south), and site length of season. Cabernet sauvignon needs a growing season of 182 days, that's the time from the last frost in the spring to the first frost in the fall. Sussex County for example, is at least 30 days short. Only an early maturing variety will ripen here.

After all of this and a whole lot more, some people decide to start a vineyard and a winery. Of course, they will also have to learn how to make wine and build a winery. That takes more money, time, experience, a lot of reading, and maybe hiring a consultant. Many of the 54 wineries in New Jersey have started in this way. I like to think that I'm not only helping the wine business in this state to grow but also preserving farms and open space. The New Jersey Wine Industry is keeping the "Garden" in the Garden state but to be a part of it takes a lot of planning and learning.

IPM

DIAMONDBACK MOTH MATING DISRUPTION

Thomas P. Kuhar[1], Taylore Sydnor[1], Alejandro Del-Pozo[2], Ashley Edwards[3]
[1]Virginia Tech Dept. of Entomology, Blacksburg, VA
[2]Virginia Tech Hampton Roads AREC
[3]Virginia Cooperative Extension, Carroll, Grayson, & Wythe Counties
e-mails: tkuhar@vt.edu; hdoughty@vt.edu; adelpozo@vt.edu; aledwards@vt.edu

Diamondback moth [DBM, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae)], is the most important lepidopteran pest of brassica crops (cabbage, broccoli, collards, etc..) globally including the U.S. Damage is caused by larval feeding and contamination of harvested marketable portions (heads or leaves) by frass, larvae, and pupal cocoons. It is estimated that this pest has an annual global cost of $5 billion in crop losses and insecticide costs. DBM is such a significant pest because of its ability to rapidly develop resistance to insecticides due, in part, to its rapid generation time (especially for a lepidopteran pest) and its monophagous nature feeding only on brassica plants that are frequently treated even in the greenhouse. It is ranked second among arthropod pest species in insecticide resistance development (97 insecticide active ingredients including 26 chemicals in the U.S. alone).

Widespread resistance and reduced susceptibility of many registered insecticides has caused uncertainty among growers as to which products will be effective and an over-reliance on intensive insecticide programs targeting DBM. It is clear that DBM drives most spray programs in brassica production. Alternatives to insecticides for DBM pest management should be explored.

Mating disruption is an IPM approach that is compatible with reducing reliance on insecticides and enhancing natural enemies for biological control. Mating disruption involves releasing large amounts of synthetic sex pheromone to disrupt the normal in-flight process of mate location. When male moths are unable to find females, they are unable to mate, which reduces the establishment of DBM larval infestations. Using the two key components of the natural DBM sex pheromone, (Z)-11-hexadecenal and (Z)-11-hexadecenal acetate (Tamaki et al. 1977), researchers were able to successfully disrupt male DBM moth orientation to pheromone traps in the field (Chisholm et al. 1983) and reduce concomitant larval infestations (McLaughlin et al. 1994). In the 1990s, mating disruption was promoted as an insecticide resistance management tool for DBM (Roush 1997), . but the approach was not widely adopted due to inconsistent results with early pheromone dispensing systems and sprays that required re-applications (McLaughlin et al. 1994, Mitchell et al. 1997, Schroeder et al. 2000, Mitchell 2002, Wu et al. 2012). The pheromone

industry showed a lack of interest in developing DBM products due to a plethora of new lepidopteran insecticides that became available in the 1990s. However, recent advancements in pheromone dispenser technology (slow-release season-long capabilities), improved understanding of the mechanisms of mating disruption (Miller et al. 2006, 2010, Miller and Gut 2015) and the widespread occurrence of DBM populations resistant to most of the newer lepidopteran insecticides such as diamides (Coragen), has rekindled interest in mating disruption as an alternative IPM tactic for DBM.

In 2022 and 2023 in Virginia, we evaluated a new mating disruption technique of installing rubber MESO™ dispensers from Trécé Inc. (Adair, OK) high-dose concentration that provided season-long slow release of the DBM sex pheromone. Designed in a high dose dispenser that could be fastened to a wooden stake, we installed four dispensers per acre (Fig. 1). Dispensers remained in the field for the entire season.

In 2022 research was conducted in Carroll County, VA where there is a sizable commercial cabbage production. Twelve cabbage fields ranging from 5-30 acres were divided into 6 treatment vs. 6 control. The fields were at least one mile apart to prevent mated flight interference. A total of 4 DBM high-dose pheromone dispensers were installed per acre in treatment fields. In both the MD fields and the paired control fields, three pheromone-baited PHEROCON IC® sticky traps were installed in the middles of each field to capture adult male DBM moths (a moth catch on a trap represents the possibility of a successful mating event in the field, and thus assesses efficacy of the strategy). Traps were checked for adult moth capture every week throughout the crop season. In addition, densities of DBM larvae and all pests as well as leaf defoliation was assessed weekly.

We repeated the experiment in 2023 in one treated and two control broccoli fields in Mechanicsville, VA and two treated and one control field in Carroll Co., VA. Again, fields selected were located at least one mile apart to prevent flight interference between plots, and crop damage, larval presence, and traps were checked weekly.

Results in both years demonstrated clear shut down of moth catch in the mating disruption fields (Fig. 2); this also led to significant differences in leaf damage to the crops (Fig. 3). Similar results were obtained in North Carolina by Drs. Jim Walgenbach and George Kennedy, as well as South Carolina by Dr. Tom Bilbo (unpublished data).

Mating disruption works as a control tactic for DBM! Now, where do we go from here? Future research will investigate additional slow-release pheromone dispenser technologies as well as how MD can be implemented into a multi-pest IPM program to help alleviate unneeded insecticide applications. Hopefully, once DBM is eliminated as a primary pest, many of the costly insecticide sprays can be removed.

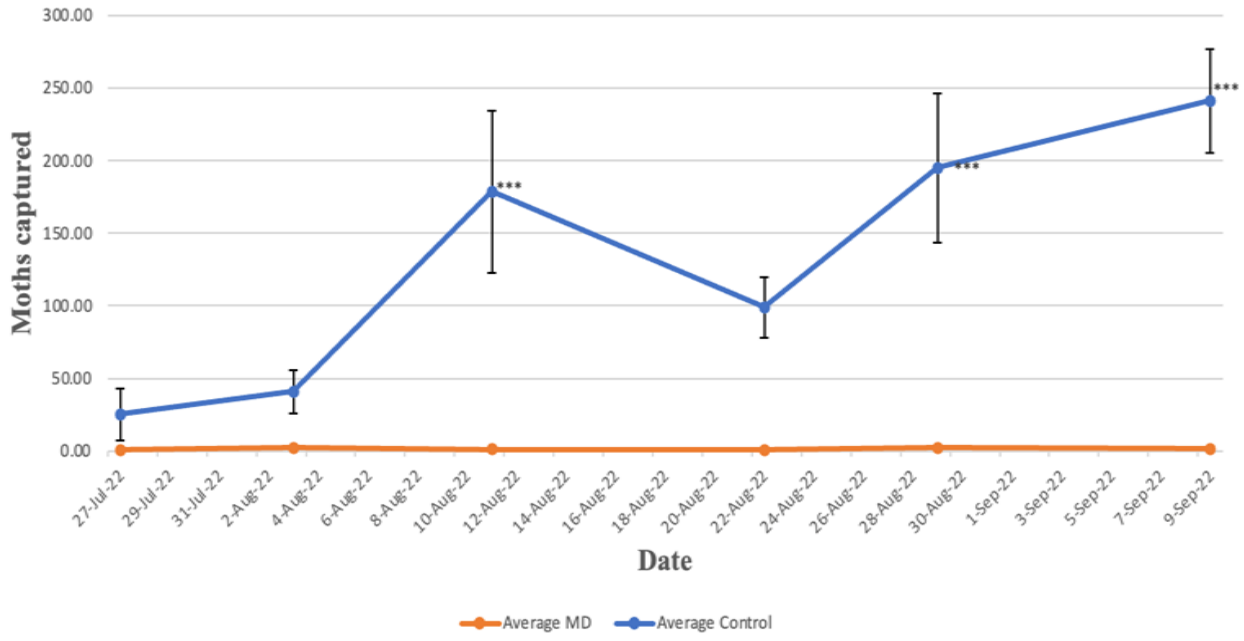


Fig. 1. MESO pheromone dispenser in a cabbage field. Photo credit: Taylore Sydnor.

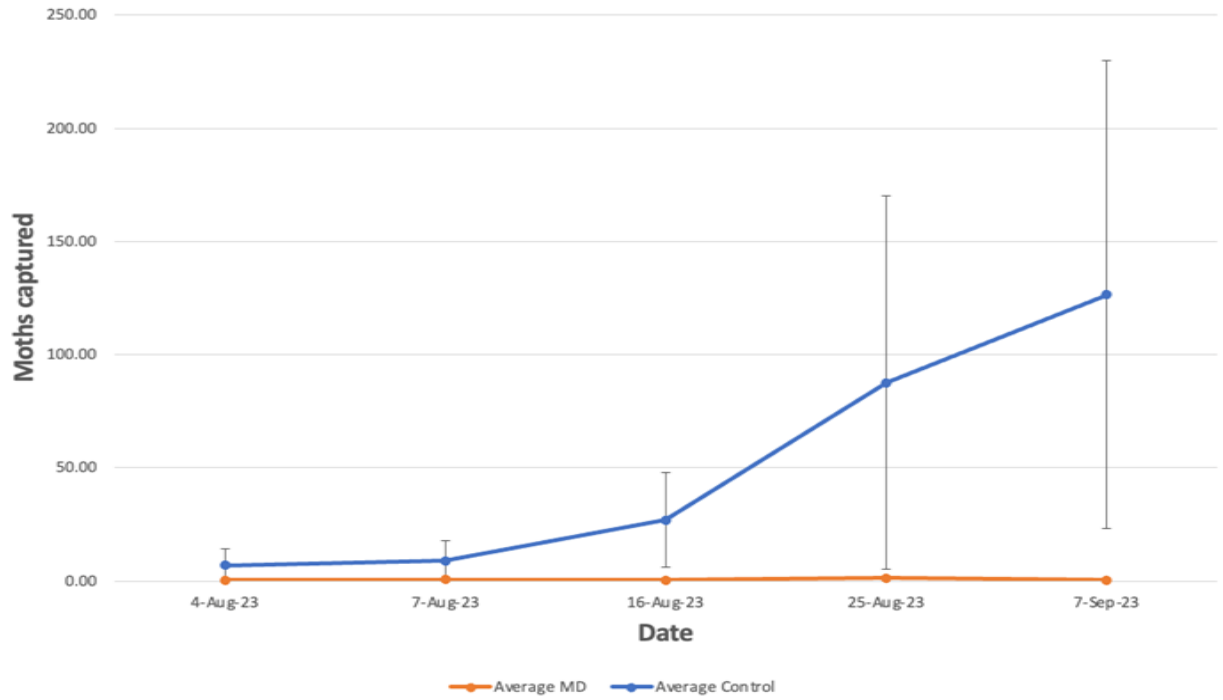


Fig. 2. Weekly catch of diamondback moths (mean ± SE) in baited sticky traps placed in the centers cabbage fields treated with mating disruption dispensers (n= 6) vs. control (n=6) in 2022 (top graph); and two treated fields and one control field in 2023; Carroll County, VA. (Taylore Sydnor – doctoral research data).

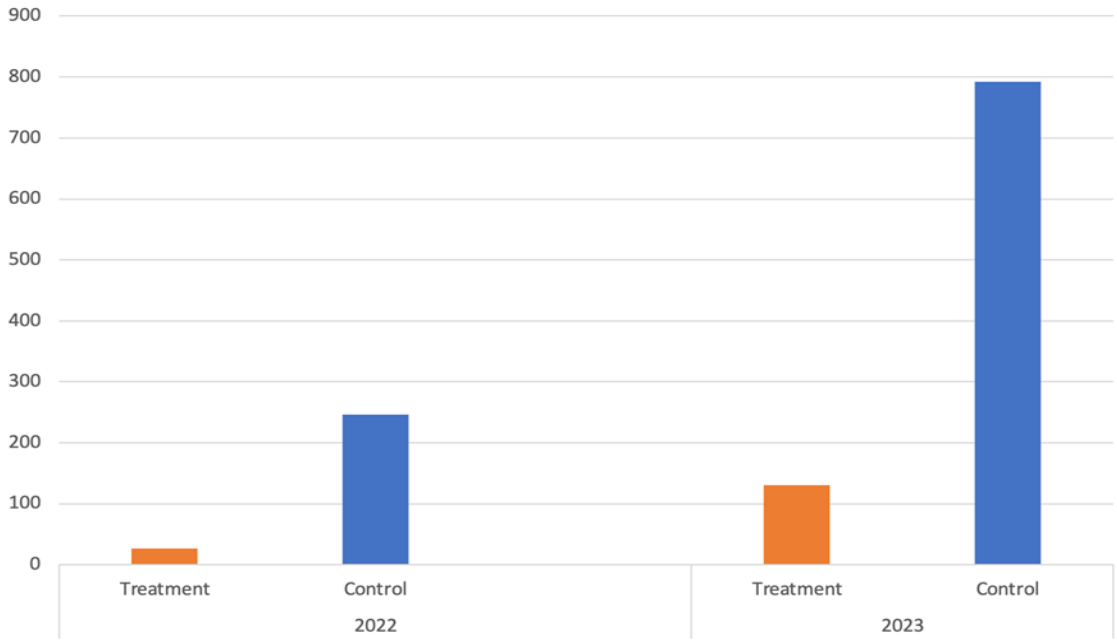


Fig. 3. Leaf damage ratings (cumulative # leaves damaged per 30 random leaves per wk per field) between cabbage fields treated with mating disruption dispensers vs. control in 2022 and 2023 (Taylore Sydnor – doctoral research data).

Reference cited

Chisholm, MD, EW Underhill, P Palaniswamy, and VJ Gerwing. 1984. Orientation disruption of male diamondback moths (Lepidoptera: Plutellidae) to traps baited with synthetic chemicals or female moths in small field plots. J. Econ. Entomol. 77: 157-160.

McLaughlin, J.R., Mitchell, E.R. and Kirsch, P. (1994) Mating disruption of diamondback moth (Lepidoptera: Plutellidae) in cabbage: reduction of mating and suppression of larval populations. Journal of Economic Entomology, 87, 1198–1204.

Miller, J. R., L. J. Gut, F. M. de Lame´and L. L. Stelinski. 2006. Differentiation of competitive vs. non-competitive mechanisms mediating disruption of moth sexual communication by point sources of sex pheromone: (Part 1) Theory. J. Chem. Ecol. 32: 2089–2114.

Miller, J. R., P. S. McGhee, P. Y. Siegert, C. G. Adams, J.Huang, M. J. Grieshop, and L. J. Gut. 2010. General principles of attraction and competitive attraction as revealed by large-cage studies of moths responding to sex pheromone. Proc. Natl. Acad. Sci. U S A. 107: 22–27.

Miller, JR and LJ Gut. 2015. Mating disruption for the 21st century: matching technology with mechanism. Environ. Entomol. 44: 427-453.

Mitchell, ER. 2002. Promising new technology for managing diamondback moth (Lepidoptera: Plutellidae) in cabbage with pheromone. J. Environ. Sci. Health B37: 277-290.

Mitchell, E. R., G. Y. Hu, and J. S. Okine. 1997. Diamondback moth (Lepidoptera: Plutellidae) infestation and parasitism by *Diadegma insulare* (Hymenoptera: Ichneumonidae) in collards and adjacent cabbage fields. Fla. Entomol. 80: 54–61.

Schroeder, P.C., Shelton, A.M., Ferguson, C.S., Hoffmann, M.P. and Petzoldt, C.H. (2000) Application of synthetic sex pheromone for management of diamondback moth, *Plutella xylostella*, in cabbage. Entomologia Experimentalis et Applicata, 94, 243–248.

Tamaki, Y., Kawasaki, K., Yamada, H., Kashihara, T., Osaki, N., Ando, T., Yashida, S. and Kakinohama, H. 1977. Z-11-Hexadecenal and Z-11-hexadecenyl acetate: sex pheromone components of the diamondback moth (Lepidoptera: Plutellidae). Applied Entomology and Zoology, 12: 208–210.

Wu, QJ, SF Zhang, JL Yao, BY Xu, SL Wang, YJ Zhang. 2012. Management of diamondback moth, *Plutella xylostella* (Lepidoptera: Plutellidae) by mating disruption. Insect Sci. 19: 643-648.

Acknowledgement
This work was funded in part by: USDA-NIFA CPPM Grant No. 2023-70006-40605. Walgenbach, Kuhar, Kennedy. “Integrating mating disruption as a key component of diamondback moth management in Brassica crops.”

PLANS TO UPDATE CORN EARWORM MANAGEMENT AND WHAT TO DO IN THE MEANTIME

Kelly Hamby
Associate Professor and Extension Specialist
Department of Entomology
University of Maryland
4112 Plant Sciences
College Park, MD 20742
kahamby@umd.edu

Corn earworm management challenges

Corn earworm (*Helicoverpa zea*) damages many crops and currently drives sweet corn pest management decisions. Consumers of fresh market sweet corn typically do not tolerate caterpillars or caterpillar damage to the ears, and though damaged tips may be removed for processing markets the amount of damage accepted has decreased and the cost of ear cleaning reduces profits. Indeed, many producers report that management has become more difficult, more expensive, and less effective. A combination of factors may explain increases in corn earworm damage including 1) more successful overwintering and overwintering further north; 2) reduced susceptibility to insecticides, especially pyrethroid (group 3A) insecticides as well as Bt hybrids expressing Cry1Ab (Attribute series) and Cry1A.105+Cry2Ab2 (Performance series) insecticidal proteins; and 3) uncertainty and variability in predictions of moth pressure and damage. Further complicating corn earworm management, some produce outlets have begun to initiate company policies that restrict management options.

Proposed work

A regional team with IPM, entomology, agricultural chemistry, geospatial analysis, ecoinformatics, economics, sociology, evaluation, and extension expertise is partnering with producers, crop consultants, industry, and extension personnel to develop corn earworm management solutions and deliver user-friendly resources. To better understand whether corn earworm pest pressure has increased as a result of climate change and warmer winters, we plan to determine when corn earworm first become active and whether they are from locally overwintered populations, migrants from further south, or a combination of both. We also will measure their overwintering success across multiple years to identify factors that may predict pressure. More successful overwintering and earlier pressure may also increase insecticide selection pressure and insecticide resistance issues. To better understand regional variation in their susceptibility to insecticides, we will monitor for resistance to 1) Bt hybrids, especially Attribute II and Attribute Plus which currently provide near 100% control, 2) pyrethroid insecticides which vary in their efficacy from location to location and over the season, and 3) other important groups including diamides (group 28) and spinosyns (group 5) as needed. This will help producers select the most effective products and identify other ways to optimize applications for improved control.

Reliable monitoring and decision thresholds are the cornerstone of every IPM program and essential for effective and economic management decisions. Corn earworm trap captures are highly variable and acceptable damage as well as other aspects of sweet corn production have changed since corn earworm action thresholds were last carefully

examined in the early 90s. Therefore, we plan to optimize pheromone trap based monitoring for corn earworm and determine the most effective spray intervals for different levels of moth pressure. Although Performance series Bt hybrids do not provide complete control of corn earworm, longer spray intervals can be used. We will conduct this experiment with a matched non-Bt and Performance series hybrid so that we can develop threshold recommendations for both production systems and compare the economic costs and benefits in each system. We also plan to compare spray programs to optimize affordable and effective control of insect pests with more selective reduced risk insecticides (e.g., chlorantraniliprole) that reduce impacts on natural enemies and pollinators. Economic cost benefit analyses, on-farm experiments, extension resources, and stakeholder interviews will help us develop and share affordable and feasible corn earworm management solutions. Finally, we plan to develop a website that helps make existing and new resources widely available to producers and to develop new tools that help predict corn earworm pressure. Specifically, a risk map that displays current regional trap captures and models that help us understand regional variation in corn earworm population growth and movement.

Current best practices

Corn earworm management starts with hybrid selection. Bt hybrids expressing insecticidal proteins from the soil bacterium *Bacillus thuringiensis* (Bt) contribute to corn earworm management, with Attribute II and Attribute Plus series hybrids (Cry1Ab and Vip3A proteins) providing excellent control without the need to spray for any caterpillar pests, including corn earworm. On some farms a spray for sap beetles may be necessary during silking with these hybrids, but otherwise ears are protected. However, corn earworm's widespread resistance to the other proteins means that insecticide sprays during silking will be necessary. Performance series hybrids (Cry1A.105+Cry2Ab2 protein) no longer provide sufficient standalone control when corn earworm moth activity is high, but may require fewer sprays that Attribute or non-Bt hybrids and provide control of fall armyworm (*Spodoptera frugiperda*) and European corn borer (*Ostrinia nubilalis*). Corn earworm is highly resistant to Attribute (Cry1Ab protein) series hybrids which also do not control fall armyworm; however, they currently do still provide control of European corn borer. Although this is unlikely to change in the next few years, it may be worthwhile to start paying attention to European corn borer, especially during whorl stages because European corn borer resistance to Cry1Fa has been documented in Canada with early warning signs of Cry1Ab, Cry1A.105, and Cry2Ab2 resistance in eastern Canada. Attribute series hybrids require silking sprays for corn earworm and/or fall armyworm.

To achieve fresh market quality ears, unprotected non-Bt hybrids require insecticide sprays during silking to control corn earworm. Silking spray programs should begin when the ear shanks emerge and/or the very first silks appear and can be terminated up to 5 days before harvest when moth activity is lower. These sprays will also control fall armyworm and European corn borer which have been much less abundant than corn earworm in recent years; therefore, silking spray schedules are typically determined by corn earworm trap captures, geographical location, time of the year, and market. Current corn earworm decision thresholds vary slightly depending on region and the type of trap used. Commonly <1 moth per pheromone trap per night indicates sprays can be skipped and/or longer 5-6 day schedules, and captures of >10 moths per pheromone trap per night would warrant 2-3 day schedules. Local trapping information

provides the best precision for timing silk sprays. Geographical location impacts corn earworm pressure due to weather fronts that bring in migratory moths as well as local temperatures which impact the growth rates of silks and corn earworm. Both silks and corn earworm grow faster at warmer temperatures (>80°F), and tighter intervals may be appropriate due to the combination of unprotected silk tissue and larvae reaching the protection of the husk more quickly. Corn earworm pressure tends to be highest later in the summer (mid-July through September). During heavy pressure periods it is important to keep an eye on preharvest intervals (PHI), or the legal days prior to harvest, to determine when to stop silking sprays. Application best practices that promote good coverage such as using enough carrier water (gallons per acre) and wetting agents can help improve control in heavy pressure situations. Remember that rainfall and overhead irrigation will wash away insecticide residues, and reapplication when the foliage dries may be necessary. Resistance to pyrethroid insecticides (group 3A) has been documented in multiple corn earworm populations, and this group should be rotated with other groups and used with caution. Products containing Insecticide Resistance Action Committee (IRAC) group 5, 5+18, and 28 work well for corn earworm. Entrust (group 5) is the most effective OMRI-listed product for organic management of corn earworm.

AG PEST MONITOR: A NEW APPROACH TO PEST MONITORING

Joseph LaForest, Public Service Associate
University of Georgia
4601 Research Way
Tifton, GA 31793
laforest@uga.edu
https://www.agpestmonitor.org

Monitoring insect and disease pressure to improve management is not a new concept. That information enables farmers to time control tactics and identify any issues with the current management strategy. It is how people balance minimizing crop loss with not spending more to manage the problem than is necessary as they maximize profit of their farm.

Although farmers sometimes share this information amongst themselves through general conversations about how their season is going, it can be difficult to get a clear picture of the entire region or compare between years. Growers' cooperatives, commodity associations, crop consultants, and Extension may formalize this sharing with protocols for trapping and procedures for scouting. Often this features a coordinator to collect data from each partner, summarize it, and return an area-wide snapshot of pest and disease activity with a commentary on how to best adjust management given the current situation.

While this can be effective, the role of coordination can become complicated and time consuming when different members of the monitoring network choose to send data in phone calls, text messages, emails or even different excel spreadsheets. The voluntary nature of some networks and the many responsibilities of the people involved can lead to delays that affect the ability of the coordinator to make accurate assessments and deliver results to the community. The easier a monitoring program can make it for members to contribute while also providing a clear and reliable return on investment, the more likely the network will continue to operate.

Ag Pest Monitor (https://agpestmonitor.org) was created to minimize the effort for pest and disease monitoring programs to collect data and return timely, accurate, and actionable information. It provides multiple ways for scouts and growers to submit data including a smartphone app, website, data file upload, or scheduled pulling of data from other systems. Coordinators get a dashboard to see what data has been received and to access the private maps, charts, and tables that summarize the data into actionable information for release to their networks. Where appropriate, public online maps can be added to provide real-time updates as new data is entered. Frequently, this is done in cooperation with the local growers to ensure that any concerns of data privacy are addressed. This includes concerns about revealing who sent what data or exact locations of severe pest and disease outbreaks. When multiple groups are collecting data on the same pest in different regions, the coordinators of each network can choose what data is shared in real-time between groups. This is possible while respecting all issues of data privacy and data ownership. It can also move independent area-wide programs toward a regional or national initiative with clear benefits for all collaborators.

Although it is hosted by the University of Georgia, it is available to any group at no cost through the USDA NIFA funded Regional IPM Centers. This program is currently being used in New Jersey to support monitoring programs for corn ear worm (*Heliocoverpa zea)* through Kristian Holmstrom, and cucurbit downy mildew (*Pseudoperonospora cubensis*) and tar spot of corn (*Phyllachora maydis*) through Andy Wyenandt. Expansion of the monitoring efforts are subject to the demand for this information from growers, availability of coordinators to help steer the efforts, supplies needed for the actual monitoring, and the willingness of different individuals to participate.

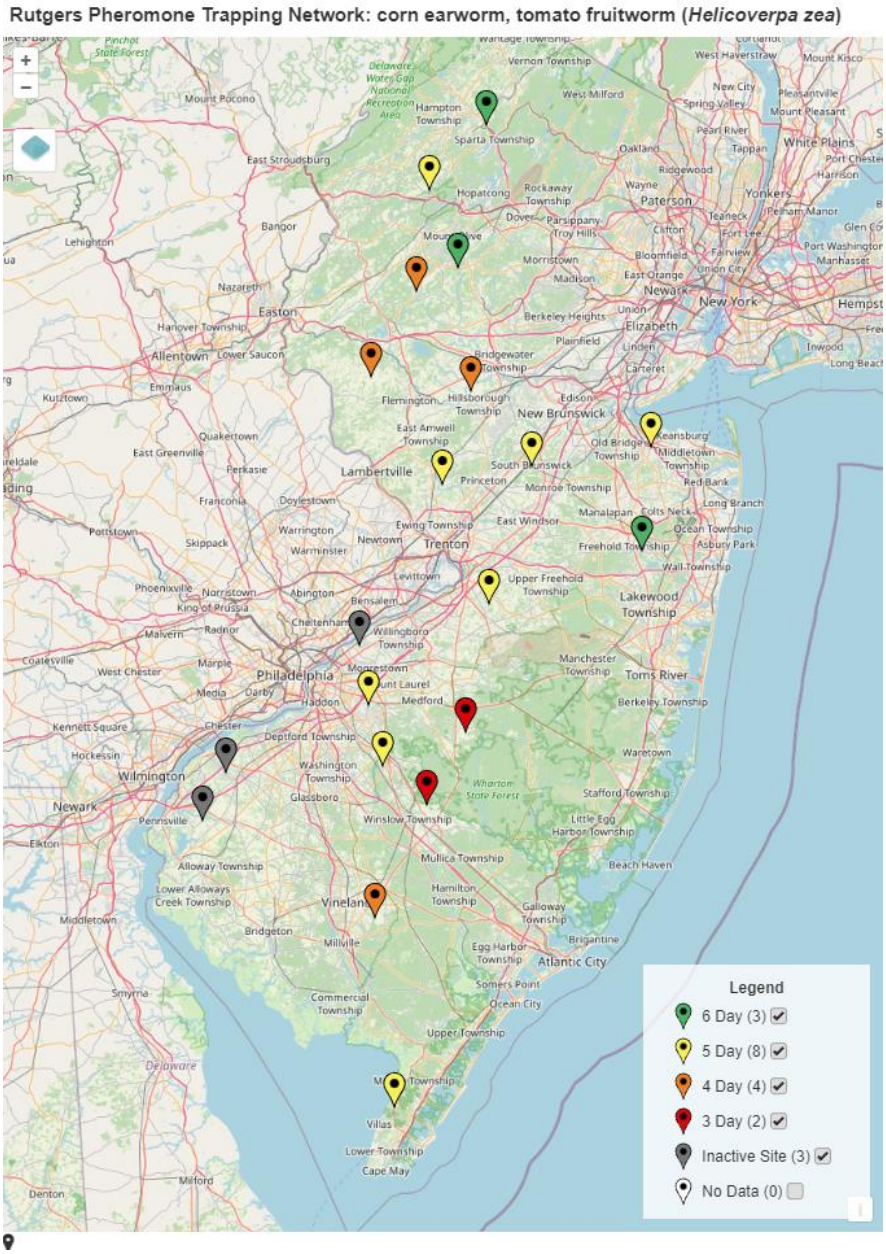


Figure 1: An example map of corn earworm pressure. Colors on the points correspond to the recommended days between treatments based on trap catches at specific locations in the state. This graphic limits how close a person can get to the exact location.

BIOCONTROLS IN HIGH TUNNELS; TOMATOES, CUCUMBERS AND GREENS

Judson Reid
Senior Extension Associate
Cornell Cooperative Extension
417 Liberty St
Penn Yan, NY 14527 jer11@cornell.edu

High tunnels are lower technology greenhouses that use the soil for crop production. High tunnels are an effective tool for farmers that desire to extend their growing season with the technology benefits of a greenhouse while using 'field' soil as a growing medium. High tunnels can be used to exclude certain pests and diseases, however the hot, dry environment can accentuate certain pests compared to field production. In the case of warm season fruiting vegetables such as cucumbers and tomatoes, this would include Western Flower Thrips, Aphids and Two Spotted Spider Mites. The soil-based nature of high tunnels can lead to overwintering of these pests as well.

The introduction of beneficial insects and mites, known as biocontrols, is an effective pest management technique for high tunnel crops. The value of early harvests, decreased number of registered pesticides for high tunnels and reduced applicator exposure justifies the long term strategy and expense of introduced biocontrols. Biocontrols are known to have a delay in control (when compared to 'sprays'), therefore must be used preventatively.

The specific biocontrol to be introduced depends on the pest species present in the high tunnel. In the case of Thrips, Aphids and Two Spotted Spider Mites there are different biocontrols best suited to control each pest.

For Two Spotted Spider Mites the predatory mite *Phytoseiulus persimilis* can be effective, more so on cucumbers than tomatoes. These highly specialized predators require high relative humidity to survive, so may require repeat releases. Other beneficials to control mites include *Feltiella acarisuga* and *Amblyseius californicus,* which could be relased preventatively in tomato seedlings. These predators are shipped in packaging that can be shaken out into the crop to assure uniform distribution.

Control of Thrips in high tunnel settings parallels Two Spotted Spider Mite Control, however we rely on generalist (vs specialist) predatory mites. These include the predatory mites:

- *Amblyseius swirskii,*
- *Amblyseius cucumeris,*
- *Amblydromalus limonica*

Biocontrols for aphids include parasitoids, which lay eggs inside aphids, or predators, which attack and consume

Figure 2. A. aphidimyza for aphid control in a high tunnel crop.

aphids. Parasitoids often target specific species of aphids, which can make biocontrol selection a challenge. An advantage of predators over parasitoids, is the wide diet range of predators. The predatory gall midge *Aphidoletes aphidimyza* is an example. This wasp preys on over 60 species of aphid. *A. aphidimyza* lays up to 70 eggs within an aphid colony. The larvae hatch and directly attack live aphids. The larvae will eventually drop to the soil to pupate and remerge as adults. The adults are night fliers attracted to aphid colonies. The potential exists to establish an ongoing population of this beneficial in high tunnels.

Some keys to success with *A. aphidimyza*:

- Scout for aphids and release early in an outbreak.
- Keep nighttime temperatures above 60F.
- Place the release bottle within crop canopy for shade and relative humidity.

Other generalist predators with increased mobility: include Lady beetles, Rove beetles and Lacewings. Note that even ‘natural’ spray materials do not combine well with the release of biological controls. Biocontrols are best introduced early within the production cycle before populations are high.

As noted above many of the specialized biocontrols require relative warm temperatures to survive and reproduce. However, high tunnels, coupled with low tunnels, are increasingly used for season extension throughout the cold of winter. Profitable crops for cold season production include spinach, arugula and Asian greens. Certain pests, such as aphids also survive, and can even thrive in low temperatures. Enclosed in the double tunnel, aphids can decimate a greens crop. To quote a winter high tunnel farmer “Pest management is so much more important in the winter because your losses are so much more.”

How do we keep our winter crops healthy? In the winter we need to focus on hardy predatory species that withstand the cold temperatures and shorter daylengths. Lady Beetles are our go-to for aphid control in winter high tunnels.
Ladybeetles will feed on a range of insects, but prefer aphids. Adult females lay clusters of orange, bullet shaped eggs on the underside of leaves near heavy aphid infestations. The larvae that hatch from these eggs do not resemble the adults, rather are elongated and multicolored. These are voracious feeders and fun to watch. A Lady Beetle can consume up to 5000 aphids during their life cycle! A final farmer quote “Natural pest control can save an entire crop. It is highly effective and valuable”

Important Tips for Biocontrol Success in High Tunnels

Figure 3. P. persimilis in a shaker bottle to be distributed in a high tunnel crop for Two Spotted Spider Mite control

- Scout often.
- Order biocontrols prior to, or immediately after finding a pest outbreak.
- Know your suppliers delivery schedules and deadlines.
- Effects will not be immediate, continue scouting.
- Plan ahead for pest intensive crops

Specialty and Niche Crops II

EXTEND THE SEASON, EXTEND THE PROFITS

Jess Niederer
Owner
Chickadee Creek Farm
80 Titus Mill Road
Pennington NJ, 08534
chickadeecreekfarm@gmail.com
www.chickadeecreekfarm.com

Chickadee Creek Farm grows certified organic vegetables on 20 acres for direct to consumer sales via 6 NJ farmers markets and a 1,000 member Community Supported Agriculture program. Sales through the extended winter season (December-April) account for 26.4% of our product sales and critically are instrumental in affording year round employment for our staff.

Major challenges to winter growing and storage of vegetables include building and maintaining protected cover tunnels and cold storage. Long term managment of high tunnels require soil soluble salt concentration monitoring and, likely, eventual remediation. Winter pest challenges include aphids, red legged winter mites, and voles. Winter diseases of significance are downy mildew of arugula and powdery mildew of lettuces.

Our winter sales consist of about a 50-50 mix of storage crops and fresh harvest greens. Variety selection had been critical. Some advice for selecting the right varieties for your climate include:

- Search yearly for performance trials.
- Prioritize DM resistance
- Summer tolerance can equal winter tolerance (eg Batavian lettuces)
- **Specific varieties we recommend:** Lettuce: panisse, magenta, berghams green. Spinach: Auroch, Oceanside, Space. Carrot: Bolero. Radish: Pink Beauty. Salad mix: salanova green varieties, red saladbowl, green saladbowl. Kale: White Russian. Napa: Minuet. Boc Choy: Joi Choi.

Managing humidity in winter high tunnels is intensive. Staff availability and your willingness to attend to tunnels daily or to invest in automated venting, is a key consideration.

By sales volume, our top winter sellers are as follows:

- Spinach
- Carrots
- Head lettuce
- Salad mix
- Potatoes

GROWING FLOWERS IN A GEOTHERMAL GREENHOUSE – A SUCCESS STORY WITH USDA REAP FUNDS

Rebecca Kutzer-Rice, Co-Owner
Moonshot Farm
415 Imlaystown Rd.
East Windsor, NJ 08520
info@moonshotfarm.com
www.moonshotfarm.com

Moonshot Farm is a specialty cut flower farm in East Windsor, NJ, growing cut flowers year round and selling primarily to retail farmers markets in NJ and NYC. In 2022, we received a USDA Rural Energy for America Program grant to convert one of our (34x96' double poly) greenhouses from propane to geothermal heat. We are using the geothermal greenhouse to profitably grow cut flowers through the winter months (November-March).

Winter Flowers - Pros and Cons

Pros of growing cut flowers in the winter include it being unique niche / less competition; we are able to hit major floral holidays like Valentine's when demand is high; customers are hungry for flowers as their own gardens are not blooming; we can grow varieties otherwise not suited to our climate/zone (e.g., freesia); we can retain employees year-round; and it can be very profitable when done correctly.

Cons of growing cut flowers in the winter include that it requires major infrastructure to scale; there is a large learning curve; pest and disease pressure is high; big risks (e.g., greenhouse could freeze); high expenses like fuel; one needs a reliable market and must sell every stem to profit; no winter "off" can mean a lot of stress; and there are ecological costs of using fossil fuels like natural gas / propane.

Converting to renewable energy can resolve one of these cons and improve the ecological costs of winter growing.

Converting to Geothermal

Our system was designed by a geothermal engineer and built by a team of subcontractors including an electrician, who ran a new electrical service to our farm. It includes two geothermal heat pumps connected to a horizontal geothermal loop, dug just outside our greenhouse.

The system is successfully heating the greenhouse to ~50-55 degrees all winter, with outside temperatures getting down to 0 degrees. A propane heater (with electrics connected to a natural gas generator) provides back-up heat in case of an emergency.

Using the system, we are able to grow winter flowers including tulips, ranunculus, anemones, freesia, and more. We are harvesting these flowers from late November through early March, a season when we would not otherwise have cut flowers without supplemental heat.

The geothermal system does use some electricity to run. We are paying on average around $200/month to pay for electricity, compared to around $1300/month in propane. We estimate that the “break even” period for geothermal vs. propane is around 8 years for a project like ours, including federal grants and tax credits.

Funding and Tax Credits

We initially received an NRCS EQIP Grant which funded the build of the high tunnel structure itself. This is a competitive program based on different ranking criteria. We have built subsequent tunnels utilizing an FSA Operating Loan, which has low rates and flexible payment options for farmers.

For the geothermal project, we received a Rural Energy For America Program (REAP) grant through USDA Rural Development agency. This grant covers renewable energy project costs such as geothermal and solar energy. We received a 25% grant but this program has gone up to 50% for the current funding period. All farmers who make the majority of their income from farming are eligible for this grant, regardless of if you are in a rural area. Additionally, all rural businesses (as defined by USDA) are eligible.

The REAP program does have some downsides. There is a long, complicated grant process, and it is competitive so funding is not guaranteed. It is also a reimbursement grant, so farmers must front the project funding and then be paid back by the grant.

The recently passed Inflation Reduction Act (IRA) includes a 30% tax credit plus 5-year accelerated depreciation for commercial geothermal projects. Utilizing this tax credit plus a REAP grant, the vast majority of costs associated with a new geothermal build would be covered with federal funding.

At Moonshot Farm, we are optimistic that geothermal energy could be the future of heated production spaces. We hope to convert more of our greenhouses to geothermal energy The geothermal project has had a ripple effect for our farm, enabling us to add new outlets and create more jobs. Customers are excited about supporting sustainability in farms.

OPPORTUNITITES, TIPS, AND CHALLENGES OF GROWING HIGH-VALUE CROPS

Devin Cornia
Executive Director
Northeast Organic Farming Association of New Jersey
386 Rock Road East
Lambertville, NJ 08530
devin@nofanj.org

Alex Sawatzky
Student Farm Manager
Rutgers University
112 Log Cabin Road
North Brunswick, NJ 08902
alex.s@rutgers.edu

Ginger

Ginger (Zingiber officinale), grown as “baby” or “young” ginger in the Northeast, is a high-value crop with a retail value between $14-$20 per pound with achievable yields ranging from 1-2 pounds per row foot. Maintenance is minimal after planting, with only standard weed control and hilling once or twice during the season required. Pest and disease pressure is low, especially in the Northeast where ginger is treated as a tender annual crop. With a diverse customer base interested in baby ginger throughout New Jersey, there is potential for ginger to boost farm sales and profitability.

While ginger has been grown successfully as a Northeast niche crop in recent years, it typically requires a substantial initial investment for seed stock and a protective growing environment (e.g., high tunnel). As ginger requires a lengthy growing season to reach a harvestable size, farmers must commit valuable growing space in protective tunnels for the entire season, which can limit profitability, especially if ginger yield does not meet farmers’ expectations. Ginger has high profit potential as a standalone crop, but the investments of money and time may deter farmers from growing ginger. If farmers can increase the overall revenue from production space dedicated to ginger by interplanting with other crops that can be harvested and sold during the first half of the season, it could further justify the time and space investment.

Even with the potential for additional income from interplanted crops, farmers may still find it difficult to allocate valuable tunnel space to grow ginger. As ginger is most commonly grown in tropical and subtropical climates around the world, it has generally been understood that protective covering is required for Northeast ginger production. However, it is possible to produce strong ginger yields by only providing a protective environment in the fall using a more affordable, temporary structure (caterpillar tunnel), and perhaps without protection altogether in the more southern regions of the Northeast and Mid-Atlantic.

Elderberry

Elder, or *sambucus*, is a fruiting plant native to Eastern North America and can be found growing wild from Canada to Florida and Texas. Elder has experienced a heightened popularity in recent years and is a promising potential crop for growers who can successfully market their harvest. From 2019 to 2021, elderberry products saw an 13% annual increase and annual sales of elderberry products are well over $300 million[1].

Elderberries are relatively easy to care for once planted and established, with no major pest or disease concerns. However, protecting one’s berry crop from wildlife along with

labor-intensive harvesting keeps elderberry production in a niche. According to one prominent NJ elderberry producer, certified organic elderberries (cleaned and destemmed) garner approximately $3.50/lb in the wholesale market. However, producers express concern over an increase in production, which may result in a decrease in market prices.

However, the savvy producer should recognize that various sales channels can exist for elder products. Elderflower can be sold to local bars, distilleries, and high-end restaurants (elderflower is the botanical used to make the liqueur *St. Germain*). Producers can also process elderberries into medicinal syrup, jams, wine and other value-added products, though profitably processing on a small scale continues to be a challenge. Agritourism is another avenue to market, with some NJ farms offering pick-your-own elderberries as well as elderberry processing classes, where attendees learn to make their own syrup and medicinal gummies. Fruit and flower aside, plants and cuttings can be sold to continue propagation of this native plant and can be marketed to growers planting to support wildlife habitat, pollinator strips, and more.

[1]https://ipmnewsroom.org/elderberries-are-a-successful-niche-crop-at-a-crossroads/
[2]https://cropsandsoils.extension.wisc.edu/files/2023/07/Growing-and-Marketing-Elderberries-in-Missouri.pdf

Additional High-Value Crops for Consideration
Producers seeking high returns on specialty crops should look towards culinary and medicinal herbs as well as producing seedlings for spring and summer plant sales. Both specialty herbs and plant sales have proven to have a high return on investment for NJ farmers with access and proximity to markets and dense population centers. This 2024 VGA session will provide more detail on both specialty herbs and plant seedling sales.

HAZELNUT CULTIVAR/POLLINIZER SELECTION & CONSIDERATION FOR ORCHARD DESIGN

David Hlubik, John Capik, and Thomas Molnar
Rutgers Department of Plant Biology, 59 Dudley Rd, New Brunswick, NJ 08901
djh222@scarletmail.rutgers.edu

Hazelnuts are a non-perishable, low input yet high value crop with a multitude of end-uses that offer substantial opportunities for direct marketing. Proper selection of cultivars and pollinizers is critical for the consistent production of high-quality nuts. World production has historically been centered in regions with Mediterranean-like climates including Turkey, Italy, and the Willamette Valley of Oregon, USA. However, due to recent breeding advances, hazelnut cultivars adapted to the Mid-Atlantic region (USDA Zones 6 and 7) are now available and are being planted. In the past, hazelnut production in the eastern United States was not possible due to the presence of the fungal stem canker disease Eastern Filbert Blight (EFB), which is endemic to the native hazelnut in this region, *Corylus americana*. The European hazelnut (*C. avellana*) is the primary species grown for consumption commercially due to its large nuts, but unfortunately most cultivars are highly susceptible to EFB. The Rutgers University hazelnut breeding program has been working for over 25 years on identifying resistance and developing new EFB-resistant cultivars adapted to New Jersey. The focus has also been on developing cultivars with very high-quality kernels so our growers can produce a premium product. In 2020, the breeding program released four cultivars: ‘Raritan’, ‘Monmouth’, ‘Hunterdon’, and ‘Somerset’, which are now available from nurseries. These cultivars produce high yields of nuts with round flavorful kernels desirable for the confectionary kernel market as well as for direct sales to consumers.

When orchards are properly designed with sufficient numbers of compatible production and pollinizer cultivars, mature plantings can yield well over 2000 lbs per acre. Fresh tree nut availability in this region is very limited, and a planting of hazelnuts may allow a grower to be one of the first in their area to have local nuts for sale at roadside stands and farmers’ markets. Hazelnuts have a long shelf life —over one year in shell—offering many opportunities for sales throughout the fall/winter season (after a September harvest) and even throughout the following spring/summer when stored properly. Additionally, value added products such as shelled kernels (raw, roasted, or candied), nut butters, oil, and various confectionary products can be made on-farm and offer additional opportunities for direct sales. Thus, hazelnuts offer many opportunities for growers to diversify their farm operations and offer a unique, high-value product for sale.

Regarding production, hazelnuts are wind pollinated and self-incompatible, therefore proper selection of production and pollinizer cultivars is important when designing and planting an orchard. Due to genetic incompatibility alleles (S-alleles), the four cultivars mentioned above unfortunately do not inter-pollinate to the degree necessary for complete coverage and additional pollinizer trees are necessary within the orchard. Fortunately, additional pollinizer cultivars are available, such as OSU 541.147 "The Beast”, Gene (NY 398), and Grand Traverse. These cultivars are “hybrids” with European hazelnuts and wild species and while they are not recommended as main

production cultivars due to their lower yields or smaller nuts, they are EFB-resistant and have diverse incompatibility alleles and appropriate bloom timing, making them useful pollinizers for all four Rutgers cultivars (Table 1). Additionally, seedling trees (from germinated seeds) from resistant breeding lines including “hybrid” hazelnuts can be used to increase the diversity of pollen incompatibility alleles and time of pollen shed in orchards as complete compatible pollen coverage of the female blooms of the production cultivars is critical to achieving high yields. Male flowers (catkins) of European hazelnuts can occasionally get damaged from cold temperatures, especially following extended warm spells in winter, but hybrid pollinizers (including the clonal pollinizers listed above) tend to have more cold hardy catkins. Thus, including them can help ensure complete pollination during challenging winters. At standard 18’-20’ spacing between rows and 10’ between trees within the row, it is recommended for every 6th row to be made up of pollinizer trees, as well as planting pollinizer trees at regular intervals within production rows. While pollinizer trees will also produce nuts, they will likely be smaller and/or lower yielding than ‘Raritan’, ‘Monmouth’, ‘Hunterdon’, and ‘Somerset’ so their incorporation should be closely considered on a case-by-case basis when designing orchards.

Hazelnuts flower early compared to other orchard crops, with the majority of bloom and pollination occurring during late February and early March in central New Jersey (Zone 7a). As mentioned, *C. avellana* catkins can be sensitive to cold temperatures once dormancy is broken, but female flowers are quite cold hardy and can tolerate very cold temperatures once emerged without damage in this region. Recent work at Rutgers University has determined chilling portion/chilling hour requirements of trees. Hazelnuts are rare in that catkins, female flowers, and vegetative buds all respond separately in late winter/spring, therefore, chilling estimates for individual plant parts are shown (Table 2). Low chilling requirements of catkins and female flowers (12 to 26 chilling portions) explain early flowering, while vegetative bud chilling requirements (32 to 42 chilling portions) are higher and should be primarily considered when looking at adaptability for a particular region especially when considering southern states production. Fortunately, these chilling requirements are relatively low and are easily fulfilled in the Mid-Atlantic region and a wide area of the northeastern U.S.

Interested growers should contact Dr. Thomas Molnar at thomas.molnar@rutgers.edu.

Tree Fruit

TREE FRUIT NUTRITION MANAGEMENT

Megan Muehlbauer
Agricultural Agent
Rutgers Cooperative Extension of Hunterdon County
314 State Route 12, Building #2
Flemington, NJ 08822
muehlbauer@njaes.rutgers.edu

Understanding and managing the nutrition levels of tree fruit is an important component of overall tree fruit care. The two primary methods of determining the nutrition levels of tree fruit are soil and leaf tissue testing.

Soil Fertility Analysis

Orchard soil fertility is analyzed to provide information on the pH and liming needs of the soil. In addition, it provides information on the nutrient availability within the soil. In order to make a decision on lime and fertilizer applications an accurate soil test must be taken. Soil samples should be taken in the fall to a depth of 18'" and they should be taken halfway between the trunk and the drip line, 16-20 cores per block in a "W" pattern (Figure 1). All cores should be mixed together then airdried and a subsample of one quart of soil should be shipped to a soil testing laboratory.

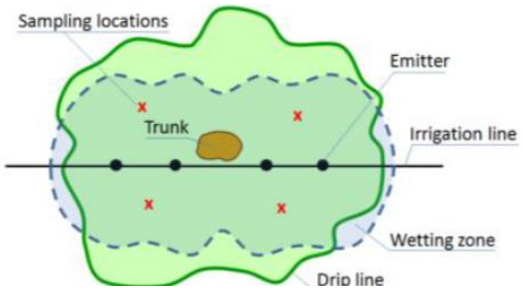


Figure 1. A diagram of where soil cores should be taken in relation to orchard trees. Diagram obtained from *Geisseler, D., and Horwath, W. 2016. Soil Sampling in Orchards. UCDavis University of California. http://geisseler.ucdavis.edu/Guidelines/Soil_Sampling_Orchards.pdf*

Soil Fertility Test Results

pH: Soil pH is a measurement of soil acidity, which affects nutrient availability, plant growth and microbial health. The optimal pH for most temperate tree fruit is 6.5. Soils in New Jersey are more commonly found to be at or below a pH of 6.5 thus the most frequent amendment used to raise the soil pH is lime. Lime should be chosen based upon the calcium and magnesium needs of the soil.

Soil testing is useful for determining the levels of both macro and micro-nutrients in the soil. These include phosphorous, potassium, calcium, magnesium, and sulfur all of which are important to maintain optimal tree fruit fertility. Micronutrients should also be monitored, these include copper, manganese, and boron.

Leaf Tissue Analysis

Leaf tissue analysis shows which nutrients are being taken up by the tree. It provides an analysis of the levels of different nutrients in the tree. Similar to soil testing, there are specific ways in which leaf tissue should be sampled in order to obtain an accurate analysis of leaf tissue nutrient levels. Samples should be taken in mid-summer. They should be recently mature leaves, from the middle of the canopy, from non-bearing shoots/spurs (Figure 2). A total of 50 leaves should be collected from about 10 trees. When collecting leaf samples, growers should try to separate samples from different varieties, trees of different ages and trees on different rootstocks.

Figure 2. This picture illustrates which leaves would be appropriate to sample for leaf tissue analysis.

Picture Obtained From Sallato, B. 2021. Leaf Tissue Analysis. WSU Tree Fruit Comprehensive Tree Fruit Site. https://treefruit.wsu.edu/orchard-management/soils-nutrition/leaf-tissue-analysis/

Leaf Tissue Analysis Test Results

Leaf tissue analysis provides information on the levels of all macro and micronutrients that can be found in the soil, however these results indicate how much of those nutrients have been taken up into the trees. Leaf tissue analysis is particularly useful because it will also show the levels of nitrogen in the tree which is one of the only nutrients that cannot be measured from a soil test.

Macronutrients and Tree Fruit Nutrition

Nitrogen: This nutrient can only be monitored from leaf tissue analysis. It is a major building block to both plant tissue and chlorophyll. Deficiencies in tree fruit are most often manifested as stunted growth and yellowing of leaves.

Phosphorous: Phosphorous is critical for root growth and development. Phosphorous deficiencies are not frequent in tree fruit grown in New Jersey. It is still important to monitor to ensure that unnecessary phosphorous is not added to soil amendments.

Potassium: Potassium is also important in root development, and growth as well as fruit coloring, flavor and size. Potassium is more subject to leaching as it does not attach to

soil particles as strongly, thus when there is a lack of water it can be more difficult for a plant to take up potassium.
Calcium: Calcium aids in development of cell wall strength. Deficiencies can lead to pitting, poor fruit quality and floral formation issues. Calcium amendments are closely linked to pH and lime amendments.
Magnesium: Magnesium is an essential nutrient for chlorophyll production and photosynthesis. Deficiency symptoms are observed as leaf yellowing, necrosis, and blind wood. Magnesium is also associated with the pH and can be amended with certain types of lime.
Sulfur: Sulfur was only recently considered a macronutrient. It is an important factor in basic metabolism, proteins and hormones. Deficiency is observed as poor growth, and yellowing of leaves, similar to that of nitrogen deficiency.

Micronutrients and Tree Fruit Nutrition
Copper: Copper is important in basic metabolism, fruit flavor, and color. Deficiencies are observed as withering of growing tips in the middle of the season. Deficiencies are far less common in orchards receiving regular copper sprays.
Manganese: Manganese is important for basic plant metabolism, proteins and hormones. Deficiency is less common than toxicity which can occur when soils have adequate or high levels and a pH lower than 5.5.
Boron: Boron is important to cell wall structure, fruit set, and seed development. Deficiencies are manifested as internal breakdown and premature drop of fruit. Growers should apply a small amount of boron (1-2 lb/acre) every year to the herbicide strip as soils in New Jersey tend to be low in boron.

Soil Testing Laboratories in the Northeastern United States

Rutgers University Soil Testing Laboratory
E-mail: soiltest@njaes.rutgers.edu Phone: 848-932-9295
https://njaes.rutgers.edu/soil-testing-lab/

Cornell University Soil Testing Laboratory
E-mail: soilhealth@cornell.edu Phone: 607-227-6055
https://soilhealthlab.cals.cornell.edu/testing-services/

Penn State University Agricultural Analytical Services Laboratory
E-mail: aaslab@psu.edu Phone: 814-863-0841
https://agsci.psu.edu/aasl/soil-testing

Waypoint Analytical
E-mail: supportlpa@waypointanalytical.com Phone: 717-656-9326
https://soilhealthlab.cals.cornell.edu/testing-services/

Leaf Tissue Analysis Laboratories in the Northeastern United States

Penn State University Agricultural Analytical Services Laboratory
E-mail: aaslab@psu.edu Phone: 814-863-0841
https://agsci.psu.edu/aasl/soil-testing

Waypoint Analytical
E-mail: supportlpa@waypointanalytical.com Phone: 717-656-9326
https://soilhealthlab.cals.cornell.edu/testing-services/

USING IPM TO CONTROL ORCHARD PESTS AND DISEASES

Janet van Zoeren
Fruit Integrated Pest Management Specialist
Cornell Cooperative Extension
12690 NY 31
Albion, NY 14411
jev67@cornell.edu

Integrated pest management (IPM) includes practices such as monitoring and thresholds, precision weather-based spray schedules, and a preference for preventative and low-impact management practices. This is particularly important in fruit crops, where pest pressure is often high, and tolerance for damage and profit margins are low. We will discuss basic IPM principles briefly, followed by examples of how to implement those principles in managing several key apple pests. We will finish with a list of resources that can help orchard managers to identify, monitor, and manage the pest complex found in their trees.

Explanations of IPM often describe pest management options in terms of a pyramid, in which the base of the pyramid represents management practices that are done most often and are most foundational to integrated pest management. The base of the pyramid includes practices that are more preventative and low impact/toxicity, whereas the top of the pyramid includes practices that are reactive/interventional and high impact/toxicity. Along with the pyramid, integrated pest management decisions follow a flow chart in which you begin by 1) identifying the pest(s), then 2) monitoring to determine if management is necessary and if so the optimal timing, then 3) choosing the best management practice(s), and finally 4) evaluating the efficacy of your management. With this flow chart in mind, we will discuss: 1) some of the most common apple pests, 2) how to monitor for those pests, and 3) some of the more common management options.

Apples are fed on by a wide range of insect pests, which can be divided into “direct pests”, which feed on the apple fruit itself, and “indirect pests” which feed on the leaves, trunk, or roots of the tree. The most damaging are the direct pests, because just a small blemish on the fruit can cause it to be unprofitable to sell. The most common direct pests of apple include several species of Lepidopteran (moth) species (codling moth, oriental fruit moth, and others), the Plum Curculio weevil beetle, and the apple maggot fly. These pests all feed on the apple fruit as larvae (although the plum curculio can also feed on the fruit as an adult). There are many species of indirect pests of apples and other tree fruits which we will not focus on due to time constraints, although resources to learn more will be provided below.

Diseases of apple include, in order of commercial importance: apple scab, which is a fungal disease affecting the leaves and the fruit; fire blight, which is a bacterial disease affecting the shoots and potentially killing the tree, and the rot complex, which are fungal diseases affecting the fruit (and sometimes the leaves). Other predominantly foliar diseases which we will not focus on include powdery mildew and leaf blotch disease.

Weeds are also important in orchard systems, because tree fruits do not have strong root systems and are weak competitors for nutrients and water. For this reason, many orchardists keep a clean herbicide strip, although alternative weed management strategies include mulching, hoeing, hand-weeding, flame weeding, or spot spraying problem weeds. The most pernicious orchard weeds are the perennial species, often including woody weeds such as sumac and poison ivy, along with herbaceous perennials such as Canada thistle and bindweed. These require diligence to manage because the plant is able to regrow from even a small segment of root, and because many of the systemic herbicides that are effective on perennial species can also be detrimental to the crop plants. Annual and biennial weeds can often be effectively managed using a pre-emergent herbicide application, and/or cultivation when weeds are small.

Once a grower has familiarized himself with the potential pest species, the next step in the IPM program is to monitor and scout for these potential problem species, and to develop a “pest map” for each orchard block, including insect, disease and weed hot-spots.

Insects are often monitored for using pheromone-based traps. These traps and lures can be purchased commercially and can be used to monitor for the moth pests and for apple maggot flies. Plum curculio is less often monitored for, but hot spots can be found by examining the fruits for damage and then marking those hot spots as problem areas on a map for future years. For moths and apple maggots, monitoring tells us not only if a pest is present, but also, if so, when to best manage for that pest. For example, many moth insecticides need to be applied when the caterpillars first hatch; to determine when that timing is growers can hang traps to catch the first adult moth flight, and then use temperature data to estimate when caterpillars are hatching. The temperature data and modeling is done automatically through the NEWA website (www.newa.cornell.edu), using the monitoring trap first catch date to determine when to begin to accumulate information.

Disease and weed pressure are measured via scouting, during which the grower walks through the orchard, usually for a set period of time, and examines the tree – fruit, leaves, shoots, and trunk – for disease symptoms, and under the tree for weeds. Again, a map of hot spots can help determine when and where to manage both this year and in future years.

Once problem areas have been identified in the orchard blocks, the next step is to find the best management strategies, focusing first on more preventative tactics such as cultural controls (i.e. pruning to reduce humidity and open up canopy to air, light and spray penetration), planting resistant varieties (especially important for apple scab and fire blight), and physical barriers to entry (such as using netting over the tree or bagging fruits to prevent pests from reaching the pest). If those tactics don’t work, other management strategies include mating disruption (preventing the male insect from finding the females by blanketing a field with the pheromone they use to find each other), biological control (living plants, insects, bacteria, or fungi used to attack and kill pest species), and chemical controls (insecticides, fungicides, and herbicides). Chemical control is the most likely to have off-target impacts, and so is the most highly

regulated. Use of more toxic chemicals requires a pesticide applicator license, and all pesticides require you to fully read and follow the label. If in doubt about whether or how to apply a pesticide, contact your local extension specialist or email me (see email address below).

Many resources are available to learn more about scouting and managing orchard pests. Some of my favorite places to begin to learn more about a specific fruit pest problem include:

- **Cornell Fruit Resources Website** – a little hard to navigate, but a lot of information http://fruit.cornell.edu/
- **University of Minnesota Extension Fruit Resources** – tons of information, much of it geared toward homeowners https://extension.umn.edu/find-plants/fruit
- **Apple IPM for Beginners** – scouting and basic management guide for apple pests https://bpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/0/7265/files/2016/12/Apple_IPM_Beginners-21ahj65.pdf
- **Stone Fruit IPM for Beginners** – scouting and basic management guide for stone fruits https://www.canr.msu.edu/ipm/uploads/files/StoneFruit-FactSheets-WEB-FINAL.pdf
- **Ontario Apple IPM** – OMAFRA (Ontario, Canada) resource for apple pest management, with excellent pictures to help with identification https://www.omafra.gov.on.ca/IPM/english/apples/index.html

Feel free to email me with further questions – jev67@cornell.edu

Vegetable Production II

INSECT PESTS OF CUCURBIT CROPS

Gerald Brust
IPM Vegetable Specialist
University of Maryland Extension
2005 Largo Rd Upper Marlboro, MD 20774
jbrust@umd.edu

Striped cucumber beetles and bacterial wilt. Striped cucumber beetles (*Acalymma vittatum*) (SCB) are the most important insect pests of muskmelon and cucumbers in our area. They overwinter as adults and emerge when temperatures reach 54–62°F at which time they begin searching for cucurbit hosts. Volatiles produced by the plant attract SCB to cucurbits initially, then male SCBs produce an aggregation pheromone attracting more beetles. The beetles tend to mass on small plants where they eat, mate and defecate (fig 1). This type of frenzied activity where there are many beetles feeding on a few leaves or a small plant leads to increased chances of bacterial wilt development. The bacterium that causes bacterial wilt in cucurbits, *Erwinia tracheiphila*, is in the cucumber beetle's feces. As the beetles defecate on the leaves where they are feeding the bacteria can be moved into open (feeding) wounds with water that is in the form of precipitation or dew. The more beetles that are feeding and opening wounds on susceptible crops like cucumbers and cantaloupe the greater the chance of bacterial wilt infection. The bacteria multiply and block plant xylem, restricting water flow to the rest of the plant; plants wilt and eventually die. The wilting usually starts with just one heavily chewed upon leaf wilting and then this wilting progresses to the stem of the leaf and then to major vines of the plant. This process of vines and the entire plant wilting down can take 2-6 weeks after initial infection, but because the non-infected parts of the plant continue to grow growers often think when they see a plant wilt down that infection took place just within the last few days.

One additional problem with SCB and why control sprays may not work as well as they should under some conditions is that the beetles are consistently hiding at the base of the plant (in the plastic hole) where they are feeding on the stem (fig 2). Sprayers usually are set up to cover a lot of leaf canopy and often do not do a very good job of putting chemical down in the plant hole. This stem feeding can be severe enough to cause some wilting. It is hard enough to control cucumber beetles with a good cover spray, but when only small amounts of spray are reaching them down in the plastic hole they will not be controlled.

Melon types have different susceptibilities to bacterial wilt infection. Watermelon is almost immune to infection while squash and pumpkin are moderately to somewhat susceptible. Cantaloupe and cucumbers as well as some of the specialty melon types are much more susceptible. Among the most susceptible cultivars are, Honeydew 252

and HD150 which are honeydew melons; Da Vinci which is a Tuscan melon type and Miracle and Sheba which are a netted yellow-green melons. Among the most tolerant cantaloupe cultivars are Aphrodite, Athena, Accolade and Astound which are all eastern cantaloupes and happen to start with an A.

The management methods that are recommended for bacterial wilt control for most cantaloupe and cucumber varieties (using insecticides when beetles reach 1 per plant or using kaolin clay or row covers before beetles appear) work well. For the specialty melons more attention is needed to carefully follow management recommendations.

Fig. 1 Early season feeding of SCB on cucumber.

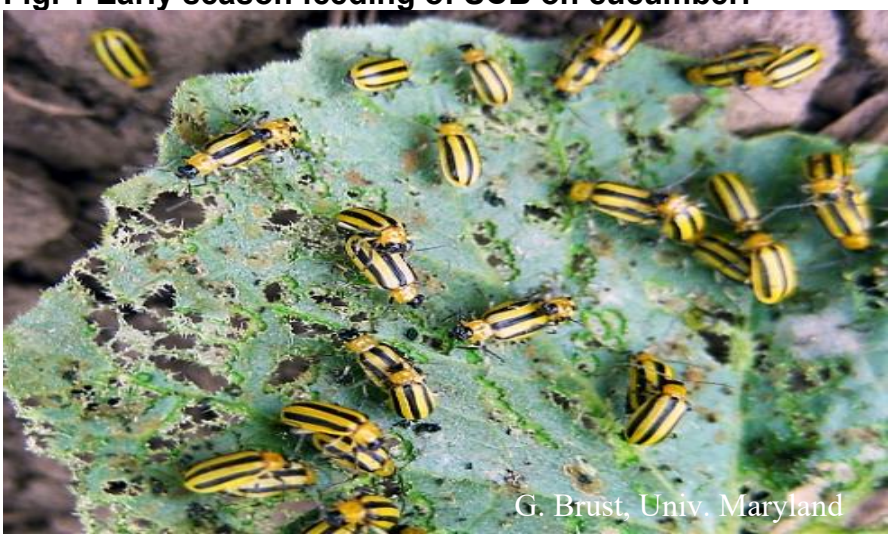


Fig. 2 Striped cucumber beetle feeding damage at base of small plants.

G. Brust, Univ. Maryland

Squash bugs damage plants by removing sap and causing leaves to wilt and collapse. Both nymphs and adults suck sap from the plant injecting a toxic substance causing a wilting known as Anasa wilt of cucurbits (fig. 3). The wilt resembles bacterial wilt, a disease caused by bacteria vectored by striped cucumber beetles. After wilting from Anasa wilt, vines and leaves turn black and brittle. Small plants are killed while larger plants may have several runners wilt. Maybe more importantly, squash bugs are the

vector of a newly recognized disease of cucurbit crops, Yellow Vine Decline. Melons, watermelon, and pumpkins are susceptible to this disease. The bacterium *Serratia marcescens*, that causes this disease, which is not the same as the bacterium that causes bacterial wilt, is injected into the plant while the squash bug feeds. The disease results in yellowing, wilting and death of the plant. Early infection by the bacteria can result in severe yield loss and therefore, it is essential to prevent early season squash bug infestations. Both Anasa wilt and Yellow Vine Decline are not common in the mid-Atlantic area presently,but should be watched for.

Fig. 3 Anasa wilt caused by squash bug

G. Brust, Univ. Maryland

Appearance: Adult squash bugs are over a half inch (15 mm) long and approximately 1/3 as wide. Adults are winged, brownish black, sometimes mottled with gray or light brown, flat-backed. Immature squash bugs are called nymphs and are whitish to greenish-gray, with black legs. Nymphs vary in size from small, spider-like individuals when first hatched, to mature nymphs, which are nearly as large as adults. Young nymphs have red legs and antennae with a green abdomen. Older nymphs are greenish-gray. Eggs are bronze colored and are laid in groups or clusters often in the angle of two veins on the underside of leaves.

Management: Early detection of adult squash bugs is very important since they are difficult to kill and can cause considerable damage. This insect can be very difficult to control when populations are allowed to build. Timing is the key to successful squash bug control. Growers should use insecticides to control squash bugs when 2 overwintering adults are observed feeding on small plants (< 3 leaves) or if two egg masses are found per plant when plants are larger. If needed early insecticide sprays should target overwintering adults on young plants. Directing these early sprays at the base of the plant will increase control.

Aphids can physically cause damage to pumpkins by sucking large amounts of sugars out of the pumpkin. But by far they do the most damage to a field of pumpkins by vectoring (transmitting) viruses such as Watermelon mosaic virus-2 (WMV), Zucchini yellow mosaic virus (ZYMV) and Cucumber mosaic virus (CMV). Once a plant is infected with a virus it cannot be cured. If the virus infection takes place before fruit set there is only a small chance that a pumpkin fruit will ever develop on that plant. The most common aphid species that land in pumpkin fields in our area are corn leaf aphid, green peach aphid, melon aphid, cowpea aphid, potato aphid, and sunflower aphid.

Only green peach aphids and melon aphids are good vectors of mosaic viruses while potato aphids are weak vectors, and corn leaf aphids are unable to vector this virus. The weeds that were found to contain WMV were shepherd's purse, Virginia pepperweed, field bindweed, dandelion, purple deadnettle, and goldenrod. Growing resistant varieties is the best most economical way to manage viruses.

Squash vine borer adults emerge from June through July from cocoons that overwintered in the soil. They typically lay their small (1/25 inch), oval, brown eggs singly on stems or leaf stalks near the base of the plant. Eggs hatch in 7-10 days. Upon hatching, the larvae immediately bore into the stem, leaving small almost invisible entrance holes and yellowish frass. After feeding for about a month the borers exit from the stem and burrow into the soil. There are 1-2 generations per year in the mid-Atlantic. Larvae damage plants by cutting the water and nutrient conducting lines. As a result, the plants start to wilt or leaves begin to turn yellow and eventually brown around the leaf margins. Other pests also cause wilting symptoms such as squash bugs, aphids, bacterial wilt which is vectored by the striped cucumber beetle or several root diseases (which are quite prevalent in Maryland). In order to determine if the squash vine borer is causing the wilting, look for a large swollen stem and large amounts of yellowish-green frass extruding from holes. If these symptoms exist, split the stems apart with a sharp knife to look for the larvae. If several larvae have infested a plant, the plant will most likely collapse and die. Management includes moving at least ½ mile from any other pumpkin or squash field that was present the year before. Pheromone traps can be used to monitor squash vine borer males and indicate when insecticide sprays should be applied to the base of the plant for 3-6 weeks depending on male moth pressure.

UNDERSTANDING AND MANAGING BLOSSOM END ROT IN VEGETABLE CROPS

Michelle Infante-Casella
Agricultural Agent/Professor
Rutgers NJAES Cooperative Extension, Gloucester County
254 County House Rd., Clarksboro, NJ 08020
minfante@njaes.rutgers.edu
https://gloucester.njaes.rutgers.edu/ag/

Blossom end rot (BER) is a common nutritional disorder of tomato, pepper, eggplant, pumpkin, squash, and watermelon caused by a shortage of calcium (Ca) in enlarging fruits. BER can cause significant yield loss in some fruiting crops, especially tomato and pepper. It is important for vegetable growers to understand how BER develops and how to manage and prevent BER to optimize fruit development and ensure yields reach their potential.

Ca plays a major role in the functions and structure of the cell wall and membranes. Ca deficiency will result in plants with weak structures and cells that collapse. Ca enters the plant from the soil solution into root cells. Soil water is key to Ca uptake by roots. In dry soils Ca uptake is inhibited. To help increase Ca levels in plants showing deficiency after leaf tissue testing some growers will apply foliar Ca. Ca applied to the leaves is inefficient and only results in about 20% absorption when applied to the leaf surface. For this reason, it is most effective to have soils with optimum levels of Ca before planting. As important is to determine nutrient ratios between cations in soil that can compete for uptake with Ca, especially magnesium (Mg) levels. High concentrations of ammonium (NH_4^+), potassium (K^+), and magnesium (Mg^{++}) cations in soil can all compete for uptake with Ca by plant roots. Therefore, if these nutrients are in excessive levels as compared to Ca, BER of fruit can occur.

Preventative methods to avoid BER include:

1. Soil test annually to determine Ca and Mg levels and soil pH levels.
2. Maintain soil pH in the 6.3-6.8 range.
3. Apply correct amounts of lime and fertilizer pre-plant and at the correct times to adjust pH and fertility levels to optimum.
4. Keep plants watered correctly through the entire growing season since fruit development occurs early in growth.
5. Regular, deep watering to encourage root growth and Ca uptake will reduce BER if calcium levels in the soil are adequate.
6. Avoid excessive nitrogen fertilizer application and choose nitrate (NO_3^-) rather than ammonium (NH_4^+) forms.

The question has been asked if different varieties are more or less susceptible to BER. Certain varieties are more susceptible to BER than others, but no varieties have shown sufficient tolerance to BER. In tomato, plum tomatoes are more susceptible to BER than other types, however most tomato types have shown BER. BER is rarely seen in cherry

type tomatoes. In pepper BER can be seen more when plants have heavy fruit load. Soil fertility and soil moisture management are key to prevention of BER.

INSECT PESTS OF SWEET CORN

Kelly Hamby
Associate Professor and Extension Specialist
Department of Entomology University of Maryland
4112 Plant Sciences, College Park, MD 20742
kahamby@umd.edu

Plant Damage	Potential Insect Pests	Management Tactics	Considerations
 Seeds	Seedcorn maggots, wireworms, white grubs, corn rootworms	Crop rotation, timing of planting, and site selection can avoid issues; seed treatment and in furrow insecticides	Can often withstand some stand loss, sporadic pests
 Seedlings	Flea beetles, stinkbugs *Caterpillars:* true armyworms, cutworms	Varieties resistant to Stewart's wilt, Bt hybrids and seed treatments provide some but not complete protection for caterpillars, insecticide application	Sporadic pests, weedy fields or small grain cover crop should be scouted closely
 Whorls	*Caterpillars*: European corn borers, fall armyworms, true armyworms, corn earworms	Bt hybrids, insecticide application if 15% (early) to 30% (mid-late) or more of plants are damaged, requires thorough spray coverage	Sporadic pests
 Tassels	Aphids, spider mites *Caterpillars:* Fall armyworms, western bean cutworms	Insecticide application, aphids and mites are not controlled by pyrethroid insecticides	Sporadic pests
 Silks	Corn rootworm beetles, Japanese beetles	Insecticides when 50% of ears have silks cut back and the plants are still pollinating	Only affect pollination at high rates of feeding
 Ears	*Caterpillars:* Corn earworms, fall armyworms, European corn borers, western bean cutworms Sap beetles, aphids, stink bugs	Bt hybrids contribute to control of caterpillar pests, varieties with long husk around the silks can reduce sap beetle damage, insecticide applications	Frequent pyrethroid insecticide applications contribute to aphid outbreaks on husks

Controlling caterpillar pests with Bt hybrids
Sweet corn hybrids expressing single or multiple insecticidal proteins derived from *Bacillus thuringiensis* (Bt) bacteria (Performance, Attribute, Attribute II, and Attribute Plus Series) provide protection against key caterpillar pests throughout the season. Their efficacy depends upon the specific pest and hybrid.

Attribute II and Attribute Plus series hybrids (Cry1Ab + Vip3A proteins) provide near 100% control of all caterpillar pests of sweet corn, especially whorl and ear invading caterpillars such as European corn borer (*Ostrinia nubilalis*), fall armyworm (*Spodoptera frugiperda*), and corn earworm (*Helicoverpa zea*). In addition, they provide control of western bean cutworm (*Striacosta albicosta*) in the ear and likely suppress armyworm (*Mythimna unipuncta*) and black cutworm (*Agrotis ipsilon*) in the seedling stage.

Performance series (Cry1A.105+Cry2Ab2 protein) and Attribute I (Cry1Ab protein) continue provide 100% protection against European corn borers (*Ostrinia nubilalis*) in the Mid-Atlantic throughout the season (whorl, tassels, and silks). However, areas further north are exhibiting the first signs of insecticide resistance, so it may be worth looking out for during whorl sampling. These hybrids are less effective against fall armyworm and corn earworm in the ears and require silking sprays to achieve fresh market quality. Resistance to pyrethroid insecticides (group 3A) has been documented in multiple corn earworm populations, and this group should be rotated with other groups and used with caution. Products containing Insecticide Resistance Action Committee (IRAC) group 1A, 5, 5+18, and 28 work well for ear feeding caterpillars.

Sap beetle management
Although many species of sap beetle (Nitidulidae) can damage sweet corn ears, dusky sap beetle (*Carpophilus lugubris*) most commonly occurs in Mid-Atlantic sweet corn. Because they can feed and reproduce on ripe, overripe, and rotting fruits and vegetables sanitation to reduce this habitat and therefore on-farm populations is the first line of defense and a critical component of sap beetle management. As much as possible avoid planting sweet corn near waste piles, compost piles, and woodlots. Timely removal and renovation of nearby fruit and vegetable fields after harvest also helps. Sap beetles enter through the tip of the ear and often follow caterpillar pests into the ear. Selecting varieties with long, tight husk around the silks can reduce sap beetle damage by making it harder for them to get in. Irrigation best management practices that promote optimal and consistent ear growth and help keep the tip of the ear covered also help. One timely insecticide application 5-6 days after silking first starts maximizes control of sap beetle on farms with consistent sap beetle pressure. Where sap beetles are more sporadic, begin inspecting the silk area at the tips of primary ears at pollen shed and treat when adults and/or eggs are found on 5% of the ears. Most insecticides used to control ear feeding caterpillars also control sap beetles.

Aphid management
Multiple aphid species including corn leaf aphid (*Rhopalosiphum maidis*), bird cherry oat aphid (*Rhopalosiphum padi*) and melon aphid (*Aphis gossypii*) occur in Mid-Atlantic sweet corn. Natural enemies often provide adequate control and using more selective insecticides for other pests can help avoid aphid problems. Pyrethroid insecticides (group 3A) in particular cause trouble because they do not control the aphids (or spider mites) while also impacting natural enemies. Aphid species vary in their susceptibility to

insecticides, so it can be worth determining which species is causing the damage before making a management decision. Sprays may be needed before tassel in dry seasons if 50% of the plants are infested. Emerging tassels better expose the aphids to insecticides, so this earlier timing is recommended if aphid populations are at concerning levels. Later sprays may be needed to control aphids and prevent their associated sticky honey dew and mold from building up on the husks. It is often recommended to adjust spray programs so that the first silk spray includes acetamiprid (group 4A, e.g., Assail) if aphids are found in tassels. Lannate (group 1A, methomyl) can be effective for corn leaf and bird cherry oat aphids, and Transform (group 4C, sulfoxaflor) and Sivanto (group 4D, flupyradifurone) are also effective for aphids. Other IRAC groups including 3A, 5, and 28 will not control aphids.

Thanks to Galen Dively, University of Maryland, and David Owens, University of Delaware, for their contributions to this article.

High Tunnels

CUT FLOWER PRODUCTION IN HIGH TUNNELS

Rebecca Kutzer-Rice, Co-Owner
Moonshot Farm
415 Imlaystown Rd.
East Windsor, NJ 08520
info@moonshotfarm.com
www.moonshotfarm.com

Cut flowers are one of the most profitable crops that growers can plant in unheated high tunnels. Tunnels provide many benefits to cut flowers. Diffuse light lengthens stems and tunnels provide protection from wind/rain damage on delicate blooms. Tunnels also provide some season extension, both for early spring crops and late fall crops. At Moonshot Farm in Central NJ, we use tunnels to overwinter hardy annuals, to grow heat-loving summer flowers, and to extend our fall season past the first frost.

Early Spring Crops

Hardy annuals can be planted into the tunnel in early fall (September-October). They will settle in and stay green all winter, and then bloom in the early spring. Low tunnels made of hoops and frost fabric can be added to increase protection on less hardy varieties. Flowers in the high tunnel will grow taller than field-grown flowers and most will require extra support. In unheated tunnels, biennials can successfully be grown and achieve sufficient vernalization to bloom the following spring.

Some of our favorite flowers to overwinter in the tunnel include ranunculus, anemones, foxglove, campanula, lupine, delphinium, Bells of Ireland, scabiosa, sweet peas, bupleurum, and ammi. Flowers will typically bloom around 4-6 weeks earlier than these flowers planted in the field, allowing for a natural succession. We add shade cloth to our tunnels in mid March to help keep them cool as spring temperatures rise.

Heat-Loving Summer Crops

Heat-loving summer flower crops thrive in the high tunnel, where temperatures are often 10-15 degrees warmer than in the field. Because most summer annual flowers will thrive in the tunnel, we focus on higher-profit flower varieties. At Moonshot Farm, these include lisianthus, asters, lilies, callas, and fancy single-stemmed varieties of celosia (e.g., Act series). We do not grow dahlias or zinnias in the high tunnel as they can be prone to powdery mildew.

Fall Season Extension for Flowers

High tunnels provide some protection against light frost (above 28 degrees) and can allow for season extension into November. Frost fabric can be draped over flowers to provide additional protection. Our favorite flowers to grow in the tunnel for late fall harvests include chrysanthemums, cut flower kale, and marigolds.

Pests and Disease of Cut Flowers in Tunnels

Pest and disease issues can be magnified in high tunnels, where air flow is limited. Our major pests in tunnels include aphids, thrips, spider mites, and white flies. Biological controls including predatory insects work very well in managing most of these pests. We

also utilize insect netting on our tunnels from March through October which helps to minimize thrips, cucumber beetles, and flea beetles.

Soil-borne diseases like fusarium and fungal issues like botrytis can damage cut flower crops. Air flow is key to healthy crops and we utilize HAF fans in our tunnels to improve airflow. We also rotate crops and use biofungicides such as Rootshield to help minimize fusarium and other soil diseases. We have found a tunnel fogger to be an excellent tool in our arsenal for applying fungicides in tunnel.

A Note on Pricing

Farmers should carefully track labor and inputs when growing cut flowers in tunnels. Most cut flower crops will take significantly longer to grow than vegetable crops and labor expenses will therefore be much higher. Consumers will expect quality stems without blemishes. In our experience, customers in our region are willing to pay top prices for high quality flowers – but growing flowers in tunnels will only be profitable if farmers are willing and able to price the crop appropriately.

HIGH TUNNEL AND HOOP HOUSE CONSTRUCTION

A.J. Both
Extension Specialist in Controlled Environment Engineering
Rutgers University, Department of Environmental Sciences
14 College Farm Road, New Brunswick, NJ 08901
both@sebs.rutgers.edu

High tunnels (a.k.a. hoop houses) are greenhouse-like structures designed to be relatively inexpensive with minimal control features and without supplemental heating. The resulting low-tech structures are usually covered with a single layer of plastic film (often 6-mil polyethylene greenhouse film) and use roll-up sides as ventilation openings in the case of free-standing tunnels, or end-wall openings and push-back roof covers in the case of gutter-connected tunnels. In most cases, high tunnels are vented manually (requiring frequent adjustments during variable weather conditions), but some growers use an automated system (requiring a temperature sensor and vent motors) to maintain the desired temperature range.

While it is possible to construct high tunnels onsite with available farm labor and using readily available construction materials, most growers opt to purchase a pre-designed kit that they then put together onsite. Several manufacturers offer such kits and these kits are typically made available in different dimensions and with different features such as various construction materials, end wall designs, and vent designs. Certain design features are region specific. For example, for locations with a lot of snow, a gothic arch roof design more readily facilitates snow shedding. And for locations with high wind conditions, high tunnel designs are needed that prevent wind damage. The distance to neighboring structures (e.g., other high tunnels, farm buildings, nearby vegetation) can affect airflow patterns around high tunnels, and can therefore impact the ventilation rate. While high tunnels can absorb heat during the day from solar radiation, the absorbed heat often only helps to maintain higher temperatures during the first few hours after sunset. The amount of heat absorbed is typically not enough to provide adequate heat energy during the entire night. During cold nights, it can be beneficial to cover the crop with a protective layer that reduces the heat loss and thus maintains more desirable temperatures. But this approach increases production costs and requires more labor since the protective cover needs to be removed shortly after sunrise to prevent high moisture conditions that can harm the plants.

For tunnels that are used for crop production during the winter months, minimizing unintended air movement through small cracks and openings will help maintain adequate temperatures. For crop production during the colder months, it is also recommended to provide a temporary heating source (e.g., a propane heater) to prevent frost damage. This approach also increases production costs.
This presentation will address issues such as siting, orientation, installation, ventilation, and end wall design. Several alternatives will be presented and discussed. High tunnels have proven to increase yields of certain crops compared to field production due to the protection they provide from adverse weather conditions. But high tunnels increase the cost of crop production and should therefore be designed and operated as economically and efficiently as possible.

Nursery and Ornamentals

DEVELOPING BEST MANAGEMENT PRACTICES FOR NATIVE PLANT NURSERIES AND LANDSCAPES

William Errickson
Monmouth County Agricultural Agent
Rutgers Cooperative Extension
4000 Kozloski Road
Freehold, NJ 07728
william.errickson@njaes.rutgers.edu

Native plants are becoming increasingly popular choices for low-input ornamental landscapes in residential and commercial applications. A survey conducted in 2023 by the National Garden Club found that 18–34-year-olds purchased plants native to their region at a higher percentage than any other age group, suggesting that this market trend will continue, as the younger demographic ages and continues to purchase ornamental plants. Many nurseries and independent garden centers in New Jersey are currently growing or offering at least some native plants in response to this increasing demand. However, supplies are still limited and there are specific best management practices associated with growing, marketing, and maintaining native plants that need further development.

To determine which priorities were most important to the green industry, Rutgers Cooperative Extension developed and disseminated a state-wide native plant needs assessment survey. The survey received responses from 60 nursery and landscape professionals and is helping to guide future resource development based on the most important topics identified by these stakeholders. The results indicated that native alternatives to invasive species, deer resistant native plants, and new cultivars of native plants were among the top priorities, in addition to IPM practices, stress tolerance, and propagation protocols. Based on this direction from stakeholders, extension programming was developed to meet these needs and support the green industry in their production and marketing of native plants.

Field trials of native plants have been established at the NJAES Specialty Crop Research and Extension Center in Cream Ridge, NJ, with an initial focus on heat and drought tolerance of native ornamental grasses. Ornamental grasses are popular nursery and landscape plants that are low maintenance and deer resistant, and many native grasses demonstrate ornamental qualities as well as abiotic stress tolerance. Forty-six taxa of ornamental grasses and sedges were evaluated for their aesthetics, growth characteristics, bloom times, and summer performance in field trials at the research farm. Open-pollinated native species propagated from NJ genetics were compared to commercially available native cultivars and common non-native industry standards.

Several native grass species were among the top performers, including Big Bluestem (*Andropogon gerardii*) ‘NJ Open-pollinated’ and ‘Blackhawks’, Little Bluestem (*Schizachyrium scoparium*) ‘The Blues’, Switchgrass (*Panicum virgatum*) ‘Purple Tears’, and Coastal Panicgrass (*Panicum amarum*) ‘NJ Open-pollinated’. These taxa

demonstrated a high degree of heat and drought stress tolerance and were minimally affected by any insect or disease problems, making them strong candidates for low-input landscapes.

Propagation trials were also conducted to begin developing standardized protocols for both vegetative cuttings and seed propagation of locally collected native ornamental plants. Soft and green wood cuttings of 20 different native species were collected June through August 2023. The cuttings were dipped into rooting hormone and planted into a well-drained medium. The cuttings were then placed under a misting system to prevent them from drying out. Roots formed in 4 to 12 weeks depending on the species. Once the plants had successfully established a root system, they were potted up into larger containers and removed from the mist tables. The number of plants that successfully rooted for each species was compared to the total amount attempted to determine success rates using this propagation method. Several species were highly successful, and recommendations can be made for their vegetative propagation. Other species had a lower success rate and will require additional development of their protocols before recommendations can be made.

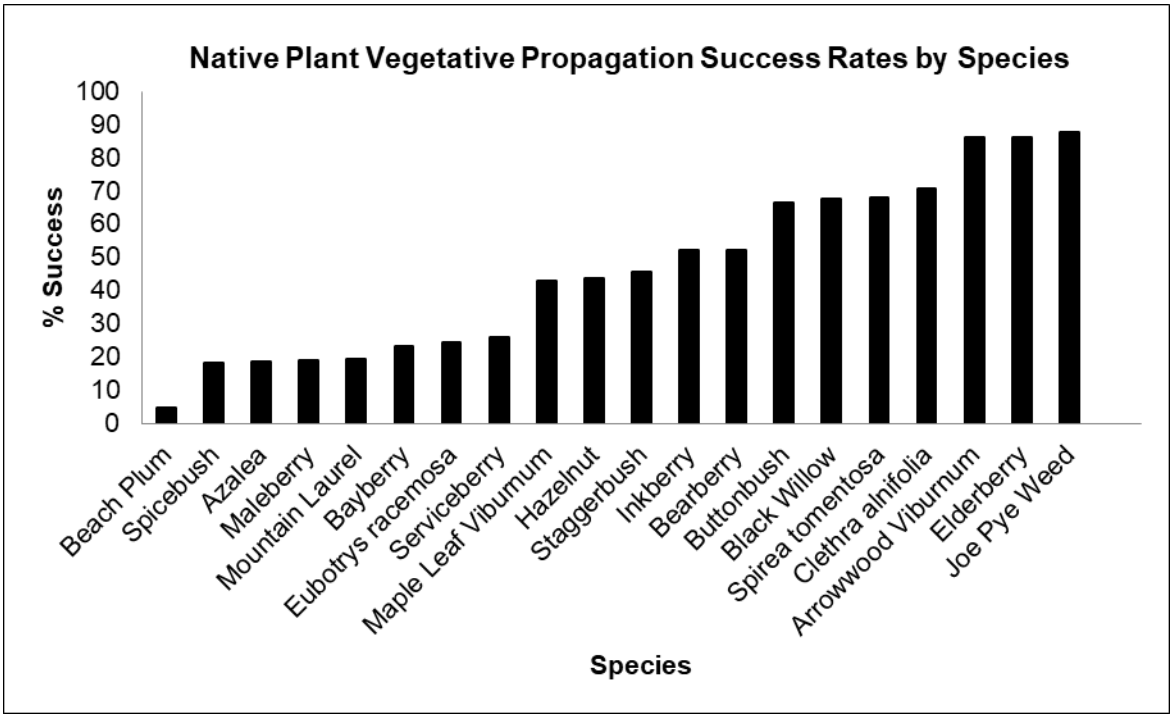


Figure 3: Rooting success rates of native plants vegetatively propagated from stem cuttings.

Native plant field and propagation trials are continuing at the Cream Ridge Extension Center to support this growing market segment of the green industry.

SOME IMPORTANT CONSIDERATIONS FOR CONTAINER PRODUCTION OF ORNAMENTAL CROPS

Raul I. Cabrera
Department of Plant Biology, Rutgers University and Rutgers Agricultural Research & Extension Center, Bridgeton, NJ 08302
E-mail: cabrera@njaes.rutgers.edu

Compared to a typical ornamental plant or tree growing in a field (mineral) soil, the same species growing in a well-chosen and well managed soilless substrate can produce a significantly larger specimen in a shorter time frame. However, the successful production and management of high-quality container-grown plants does require a basic understanding of the unique environment found in substrates, and how it is shaped and affected by its physical and chemical properties.

The roots of plants growing in containerized substrates can be exposed to a dynamically more stressful environment, particularly if we fail to provide them with timely and proper management. For example, during periods of rapid growth a plant can extract all the available water from a substrate held in a typical container (1-to-3-gallon size) in as little as few hours or a day or two (depending on environmental conditions). Conversely, heavy and frequent irrigation can saturate the pore space of the substrate and deplete or significantly reduce the air content in the rootzone, leading to anoxia (lack of enough or any oxygen), killing the roots. Also, depending on irrigation applications (volumes) and scheduling, the rootzone concentration of soluble salts derived from irrigation water and applied fertilizers can change significantly over a few hours to a couple of days, oscillating between deficiency (due to dilution by water) or excess (salinity stress). Depending on substrate volume, container geometry and color, container spacing, cardinal arrangement of the container beds in the nursery and irrigation management, substrate temperatures could exceed 120°F (root-killing threshold) and can fluctuate by 30°F or more between day and night. Thus, we have that the limited volume of substrate in a container restricts to a short time frame, compared to a plant growing in a field soil, its ability to satisfactorily meet the needs of the plant root system. Therefore, good and timely management practices are required to adequately meet the needs, and minimize stressful conditions of container-grown plants.

Of all the desirable properties and characteristics described for growing media, the physical properties of the chosen substrate are deemed as the most critical, as these cannot be easily changed or modified once the substrate is inside the containers and the crop plants have been trans/planted into them. Conversely, many of the chemical properties of the substrate can be modified or altered thereafter over the course of the crop's growing cycle.

Within physical properties, what fractions of the total porosity of a substrate are occupied by water and air immediately following a saturating irrigation event are of much importance. In here, water holding capacity tells us the fraction of a substrate's total volume (bulk volume) that is occupied by water, and air-filled porosity tells us the volume fraction occupied by air. Only a portion of the water holding capacity is available for plant uptake (for a first approximation, about one-half of it for substrates based on

pine bar and peat moss). If we know of have an idea of the plant water use per unit time (hour or day), *aka* transpiration rate, the volumetric fraction of plant available water can help us determine the irrigation interval(s) that will minimize the possibility of water stressing the crop.

While typically a good deal of attention is placed to water holding capacity and plant available water, the volume fraction of a substrate that is occupied by air (air-filled porosity) might be more critical to maximize the growth potential of a crop. Surveys and anecdotal observations point out that nursery and greenhouse growers often over-irrigate or manage the irrigation of their crops on the "wet" side. That is, frequent and heavy irrigation events are the norm, pegging the water holding capacity to the maximum limit. As the pore spaces of a substrate are filled with a mixture of water and air, this means that with over-irrigation conditions the air-filled porosity of a substrate will be low or remain on the minimum limit for extended periods of time. Solid research results from decades ago have pointed out that the rootzone air (and oxygen) requirements vary significantly among crops, and their growth and quality relies more heavily on this property than others. Table 1 summarizes the air-filled porosity requirements for some container-grown ornamental crops.

Table 1. Air-filled porosity requirements for selected ornamental crops (Bunt, 1988).

Very high (>20%)	**High (20–10%)**	**Intermediate (10–5%)**	**Low (5–2%)**
Orchids (*epiphytic*)	Snapdragons *(Antirrhinum)*	Chrysanthemum	Carnation
	Foliage plants	Gladiolus	Ivy (*Hedera*)
	Orchids (*terrestrial*)	Hydrangea	Rose
		Lily (*Lilium*)	Strelitzia

Growers need to carefully consider this property (air-filled porosity) when choosing a substrate for specific crops, and to help them manage satisfactorily their irrigation scheduling and volume applications. If budgetary or logistical constraints reduce the ability or capacity of growers to employ more than one substrate for a variety of crops, they should choose one that has an air-filled porosity of at least 10%, with ≥ 20% being a better choice. When stuck with a substrate that has reduced or substandard air-filled porosity values, careful attention to irrigation volumes and scheduling could be implemented to create somewhat "droughty" conditions in-between irrigation events, thus allowing for improved aeration values. However, this scheme could lead to unwanted water stress conditions.

A more suitable option for substrates with reduced air-filled porosities, if and when the crops have not yet been trans/planted, is to use containers with a high-profile geometry. That is, use containers of the desired rootzone volume capacity, but that have a narrow base and a tall profile. This will help spread out the stratification of substrate moisture

content along the height of the container, in such a way that it reduces the volume of substrate that is saturated after every irrigation event, and the averaged value of air-filled porosity for the entire substrate volume is effectively increased even with over-irrigation conditions.

One last thing to keep in mind. The standard (common sense) recommendation is to do or have the physical properties of a substrate determined/evaluated before it is placed into the containers and the crop(s) trans/planted into it. To do otherwise is a potentially major game of odds that can lead to costly crop performance (poor) and failures. Some of the references listed below provide information on some relatively easy-to-accomplish field (in nursery or greenhouse) procedures to estimate major physical properties. Alternatively, utilize the services of a soil testing laboratory that offers physical and chemical analyses of soilless media/substrates. To help you identify some of these lab/service providers, you might want to consult with your local/regional extension agent(s) and specialist(s).

References

Bilderback, T. 2009. A nursery friendly method for measuring air-filled porosity of container substrates. Southern Nursery Assn. Research Conference 54: 212-215.

Bilderback, T., C. Boyer, M. Chappell, G. Fain, D. Fare, C. Gilliam, B. Jackson, J. Lea-Cox, A. LeBude, A. Niemiera, J. Owen, J. Ruter, K. Tilt, S. Warren, S. White, T. Whitwell, R. Wright and T. Yeager. 2013. Best Management Practices: Guide for Producing Nursery Crops. Southern Nursery Assn., Acworth, GA.

Bunt, A.C. 1988. Media and Mixes for Container-grown Plants. Unwin Hyman Ltd., Great Britain.

Cabrera, R.I. 1997. Fundamentals of container media management, Part 2. Measuring physical properties. Factsheet FS 881. 2 pages.

Cabrera, R.I. and J.R. Johnson. 2014. Fundamentals of container media management, Part 1. NJAES and Rutgers Cooperative Extension Factsheet FS812 (revised). November 2014. 4 pages.

ORNAMENTAL REFORESTATION: A NEW HORTICULTURAL DESIGN CONCEPT TO BOOST ENVIRONMENTAL SUSTAINABILITY

Jean Epiphan
Agricultural & Natural Resources Agent
Rutgers Cooperative Extension of Morris County
550 West Hanover Avenue
Morristown, NJ 07960
jean.epiphan@rutgers.edu

Ornamental reforestation is a new concept that marries two divergent landscape intentions, the aesthetically pleasing aspects of manicured gardens and reforestation to improve environmental sustainability. Reforestation is one of the most beneficial initiatives to mitigate climate change impacts and capture carbon. Forests are ecosystem system service powerhouses that are invaluable to our societies and planet. In places where most people live, cities and suburbs, these important environmental benefits are lacking and can be boosted, especially in lawn-dominated green spaces where there is opportunity for a "greener" alternative. How can this be done while also being visually appealing to all? The specific layout and maintenance steps of ornamental reforestation result in a striking landscape addition that replicates nature, but in a tidy, modern way.

The planting concept draws from native early successional habitats, like a stand of grey birch (*Betula populifolia*), but in a clean two-layer arrangement. Proper installation is key to plant health and function as well as aesthetic design.

- The planting bed must be ground level or lowered slightly to intake stormwater, not mounded like over-mulched beds.
- The reforestation strategy employs native tree small-container stock (1-7 gallon size) planted with 3-4 foot spacing to replicate a natural, single species, stand. Trees should be planted at least 4 feet from the bed edge; this helps maintain a tidy appearance. Tree species options include grey birch, winged sumac (*Rhus copallinum*), pitch pine (*Pinus rigida*), or even the tall shrub, black elderberry (*Sambucus nigra*) if a vase-shape prune is executed to raise the canopy above 5 feet.
- The layer below serves as a contiguous "green mulch" or pollinator meadow of one, two, or multiple species of low growing native perennials (<3ft height). There are many hardy deer resistant options such as: little bluestem (*Schizachyrium scoparium*), nodding onion (*Allium cernuum*), Canada anemone (*Anemone canadensis*), bluemist flower (*Conoclinium coelestinum*), short-toothed mountain mint (*Pycnanthemum muticum*) etc. Yet, the goal in this layer is to use a limited palette for aesthetic appeal. At minimum, a 2-foot edge of the bed should be left unplanted to maintain a clean, visual separation.
- Manual maintenance is required to keep this bed tidy and weeded. Even so, perennial stems should be left standing throughout the winter which allows fallen

leaves to remain in the beds as mulch. The design of this stand allows for leaving the leaves and mulching should only be performed to lightly along the clean edge if needed to weight down leaf mulch.

- Eventually the plant root systems will grow and interlock which helps prevent windthrow, facilitate mycorrhizal communication, and stand health.

The result is a thriving, visually appealing stand of smaller-stature trees, that provide light shade over a tidy flowering meadow. Ornamental reforestation promotes habitat and climate control benefits of trees, pollinator and biodiversity benefits of meadows, stormwater interception and intake of rain gardens, the sustainability and soil quality benefits from leaving the leaves and reduces negative impacts of traditional lawn and garden care. This concept is a sustainable alternative to expansive lawns and volcano mulched trees; it is a new reforestation option for developed landscapes that require ornamental appeal.

Farmer Health and Safety

NOISE EXPOSURE AND HEARING LOSS

Ian Pracher
Rutgers Environmental Health and Safety
74 Street 1603
Bldg. 4116 Livingston Campus
Piscataway, NJ 08854-8036
ian.pracher@rutgers.edu
https://ipo.rutgers.edu/rehs

Compliance History

The Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) in the United States are two separate entities that both established noise standards for different purposes. The EPA developed standards for environmental noise while OSHA created theirs for occupational noise. It's important to note that while the EPA and OSHA each have distinct roles, there is some overlap when it comes to regulating noise. Employers may need to comply with both EPA and OSHA regulations if their activities involve both environmental and occupational noise sources. Additionally, state and local regulations may supplement federal standards, so it's essential to be aware of and comply with all relevant requirements.

OSHA's main concern is protecting workers from occupational noise exposure. OSHA's noise standards are designed to prevent hearing loss and other adverse health effects resulting from prolonged exposure to high noise levels in the workplace. The OSHA standard for occupational noise exposure is expressed as the Permissible Exposure Limit (PEL). The current PEL for occupational noise exposure established in 1971 is 90 decibels (dB) as an 8-hour time-weighted average (TWA). No worker can be exposed to an 8-hour TWA over 90 dB without additional protection. In 1981 OSHA passed the Hearing Conservation Amendment under which employers are required to implement a hearing conservation program when workers are exposed to noise levels at or above the Action Level (AL) of 85 dB over an 8-hour TWA. Each employer's Hearing Conservation Program must include exposure monitoring, audiometric testing, hearing protection, employee training and recordkeeping. Any worker exposed to noise levels at or above 85 dB over an 8-hour TWA needs to be included in the Hearing Conservation Program. To mitigate noise, OSHA encourages the use of engineering controls, such as modifying or replacing equipment, to reduce noise levels and protect workers. Hearing protection was to be used only as an interim measure until "feasible" engineering or administrative controls could be implemented

The EPA is responsible for regulating environmental noise, focusing on community noise levels rather than occupational exposure. The EPA's authority comes from the Noise Control Act of 1972 and the Quiet Communities Act of 1978 although today they typically transfer enforcement of noise policies to state and local governments. In 1979, the EPA developed labeling requirements for hearing protection, which required hearing protection manufacturers to measure the ability of their products to reduce noise exposure. These ratings on hearing protection are called noise reduction rating (NRR). OSHA adopted the NRR but later recognized that the NRR listed on hearing protectors often did not reflect the actual level of protection, which likely was lower than indicated

on the label because most workers were not provided with fit-testing, and donning methods in a controlled laboratory setting were not representative of the donning methods that workers used in the field.

Noise Basics

Sound is measured by pressure. The human range of hearing is generally between 0.00002 Pa (hearing threshold) to 20 Pa (pain threshold). This is a very large range that makes it hard to conceptualize and work in most cases. For this reason decibels (dB) are typically used as the unit of measure for noise with 0 dB being set at the hearing threshold and 140 dB being the pain threshold. Decibels are logarithmic values, so it is not correct to sum multiple sound values using arithmetic addition. In reality, an increase of 3 dB would represent a doubling of the sound pressure. While a 10 dB change is perceived by the human ear as a doubling or halving of noise level.

Sound can also be analyzed by frequency. Sound frequency is perceived as pitch. The frequency range sensed by the ear varies considerably among individuals. A young person with normal hearing can hear frequencies between approximately 20 Hz and 20,000 Hz. As a person ages, the highest frequency that they can detect tends to decrease. The human ear responds more to frequencies between 500 Hz and 8 kHz and is less sensitive to very low-pitch or high-pitch noises. The ear is not equally sensitive to all frequencies and is most sensitive in the range of about 1–5 kHz with human speech frequencies in the range of 500 Hz to 4,000 Hz. This is significant because hearing loss in this range will interfere with conversational speech. The portions of the ear that detect frequencies between 3,000 Hz and 4,000 Hz are the earliest to be affected by exposure to noise. Audiograms are used to test an individual's hearing at different frequencies. A decrease in hearing at certain frequencies is a sign of noise induced hearing loss.

Due to the fact that human ear responds differently depending on the frequency, noise measurements are typically weighted. A-weighting is an adjustment applied to sound measurement to reflect how a noise is perceived by the human ear. A-weighted decibels are denoted as dBA. Because A-weighting reflects how a noise is perceived by the human ear, it is often used in environmental and occupational noise monitoring and for assessing the impact of noise on human health. Both OSHA and EPA use dBA for their compliance monitoring, so most noise surveys are done with A-weighting. C-weighting is always sometimes used, but that is typically for low frequency noise monitoring.

Noise Monitoring

To protect against hearing loss, areas, equipment, and activities which put employees at risk of noise exposure must be monitored and assessed. There are two basic ways of assessing noise, both of which are discussed below.

Stationary noise measurements use a sound level meter or octave band analyzer to measure noise levels in a given area. Depending on the noise levels inside a work area, warning signs or hearing protection may be required. It is a good technique to assess the noise from individual tool, piece of equipment, and job task to get a better picture of how each contributes to the overall noise to which a worker may be exposed.

Personal exposure monitoring places a dosimeter on an employee for their entire shift to calculate their TWA to see if they are being over exposed to noise. Employees will wear a dosimeter with a microphone placed in the vicinity of their ear, typically on their shirt lapel just below their ear. This dosimeter continuously logs and calculates the workers noise exposure while they perform normal work activities and tasks. These results are then compared to noise standards to see if they are above the OSHA PEL or AL. Personal exposure monitoring is used to accurately assess a workers daily noise exposure.

Audiometric Testing and Results

There are different types of hearing loss, but from an occupational standpoint we are generally concerned most with sensorineural hearing loss as it tends to be a permanent condition that is often associated with irreversible damage to the inner ear. The normal aging process and excessive noise exposure are both notable causes of sensorineural hearing loss. Exposure to noise damages the sensory cilia that line the cochlea. Even moderate noise can cause damage to these nerve cells. As the severity of the noise exposure increases or if the noise exposure is chronic, the cilia and supporting cells deteriorate and the associated nerve fibers eventually disappear.

An audiograms is an annual test that shows the softest sounds a person can hear at different pitches or frequencies. Sound levels are increased at varying frequencies to see how loud a sound must be for the person being tested to detect it. If a person cannot detect soft sounds but only loud sounds it is likely an indication of hearing loss. Occupational noise exposure is a significant cause of sensorineural hearing loss therefor OSHA requires that anyone exposed to a TWA above 85 dBA over an 8-hour TWA must have an annual audiogram as part of the Hearing Conservation Program. Hearing loss is discovered by comparing a current audiogram with an individual's baseline audiogram which is taken when the employee starts their employment at a company.

As mentioned, hearing loss presents itself as declining sensitivity to sound, first at high frequencies (4,000 Hz), and then lower frequencies as damage continues. Often the audiogram of a person with sensorineural hearing loss will show a "Notch" between 3,000 Hz and 6,000 Hz, and most commonly at 4,000 Hz. This is a dip in the person's hearing level at 4,000 Hz and is an early indicator of sensorineural hearing loss due to noise. It can be hard to determine the cause or work relatedness of sensorineural hearing loss as it can have many different causes, such as viruses (e.g., mumps), congenital defects, some medications, or natural aging. If an initial audiogram shows an average change of 10 dB in either ear at 2K, 3K, or 4K frequency and this is confirmed by a second audiogram within 30 days then it is determined that a worker has a Standard Threshold Shift (STS). A STS requires the employer to re-train the employee, evaluate their hearing protection and fit, and may be considered an OSHA recordable.

Noise Mitigation

Similar to other safety and health disciplines, the hierarchy of controls for noise emphasizes strategies to eliminate or minimize exposure to noise hazards. The typical hierarchy consists of the following levels:

Elimination or Substitution is the most effective way to control noise is to eliminate the source or substitute it with a quieter alternative. Examples include using quieter machinery, processes, or technologies to replace noisy ones.

Engineering Controls are the next preferred solution if elimination or substitution is not feasible. Engineering controls focus on modifying the workplace or equipment to reduce noise levels. Examples include installing noise barriers, enclosing noisy equipment, and implementing damping or isolating measures.

Administrative Controls involve changes to work practices and policies to limit exposure to noise. This may include scheduling noisy activities during times when fewer people are present, rotating workers to minimize exposure, and establishing quiet zones.

Personal Protective Equipment (PPE) such as earplugs or earmuffs, is the last line of defense in the hierarchy. PPE is used when other control measures are not sufficient or feasible. However, it does not eliminate the noise source.

It's important to note that the ideal approach to noise control involves a combination of measures from different levels of the hierarchy. A comprehensive noise control program typically begins with efforts to eliminate or substitute noisy processes or equipment. If this is not possible, engineering controls are implemented to reduce noise at the source. Administrative controls and the use of PPE can then complement these efforts.

The most commonly used forms of PPE to protect against noise are ear muffs and ear plugs. Ear muffs are designed with over-ear cups connected by a headband, providing external noise protection that is easy to put on and take off. They are generally more comfortable for extended use, and adjustable headbands ensure a secure fit. Ear muffs are well-suited for environments where communication is important, as they don't insert into the ear canal, facilitating conversations. They are also easier to clean and maintain.

On the other hand, ear plugs are small, flexible devices inserted into the ear canal to create a seal. They require proper insertion for effectiveness and may be less comfortable for extended use. Ear plugs are highly portable and come in both disposable and reusable options. While they can provide effective noise reduction, communication may be more challenging compared to ear muffs. Users often choose between ear muffs and ear plugs based on personal preferences, comfort, and the specific noise reduction requirements of the task or environment. Some individuals may opt for a combination of both for added protection in extremely noisy settings.

One of the most important elements to consider when selecting noise reducing PPE is the assigned Noise Reduction Rating (NRR). The NRR is numerical value assigned to hearing protection indicating the amount of noise reduction provided by the hearing protection under laboratory conditions. It's important to note that the NRR is a laboratory-derived value and may overestimate the actual protection achieved in real-world conditions. Therefore, OSHA recommends applying a derating factor to the NRR to better estimate the expected real-world noise reduction. The derated NRR is used in calculations to ensure that the selected hearing protection provides adequate protection for workers in their specific work environments.

$$NRR\ Derating = \frac{NRR\ number\ listed\ on\ the\ box - 7}{2}$$

As an example, if the NRR is listed as 33 on the box, it would be calculated that the average noise reduction provided to a worker's ear is 13 dB. Wearing ear muff together with plugs only provides an additional 5 dBA noise reduction. So in this example using ear plugs with a NRR on the box of 33 with ear muffs over top would provide a total NRR of 18 dB.

Strawberry

DISEASES TO WATCH FOR IN NEW STRAWBERRY PLANTINGS

Kathy Demchak
Extension Program Specialist
Department of Plant Science
102 Tyson Bldg.
University Park, PA 16802
efz@psu.edu

Recently, some diseases new and old have been affecting new plantings of strawberries. When they are present, symptoms are frequently apparent within the first two to three months after planting. Sometimes their symptoms can be easily confused, making it important to correctly identify the problem in order to treat it effectively. There are 5 in particular that warrant paying attention during the fall in plasticulture plantings.

Neopestalotiopsis. This disease first appeared in the Mid-Atlantic region in 2020, at first arriving on runner tips from the South that were rooted to produce plug plants. This disease first appeared in Florida in 2017 in winter production fields, and has since popped up in various states. It has also affected winter strawberry production in Mexico, where the plant source was different from those supplying runner tips in the eastern U.S. At least two different populations that aggressively colonize strawberry tissue appear to exist. The relatedness of these strains and additional details about how they might interact is a matter of investigation at the University of Florida by Dr. Natalia Peres, who has done the bulk of the work resulting in our current understanding of this disease.

The first symptoms noticed are leaf blotches that look similar to Gnomonia leaf blotch or Phomopsis leaf blight. However, the disease progresses rapidly, and if conditions are warm and wet, entire leaves can be consumed within a matter of days. This disease also causes lesions on petioles, and a crown rot resulting in plant collapse and death. 'Chandler' and 'Sweet Charlie' were often affected the most, with leaf lesions growing more slowly on 'Galletta' and 'Flavorfest'.

Phytophthora crown rot (and others). Recently growers in several mid-Atlantic states noticed that new plantings of 'Flavorfest' were collapsing. Crown tissue was reddish-brown, often in the top half of the crown, or where soil could have washed into a branch crown bud, or sometimes where a root was attached to the crown. Only fields that had previously had strawberries growing in them were experiencing these symptoms. This led us to believe that the problem was soil-borne (i.e., perhaps phytophthora crown rot). Lab work by Dr. Jill Pollock at the Univ. of Delaware showed that the problem was *Phytophthora cactorum* in nearly half of the 18 plants submitted for diagnosis, usually one of two *Pythium* species in the remainder, and *Phytopythium* in a few plants.

Anthracnose crown rot. Sometimes plants infected with anthracnose crown rot grow slowly or very little after planting. Crowns cut from top to bottom are often described as having a reddish-brown mottling, though this isn't always the case. Dark elongated lesions on the petioles and runners can be an additional clue, and so can the varieties that are affected. 'Chandler' is susceptible to anthracnose, while 'Flavorfest' and 'Galletta' are resistant.

Angular leaf spot. This disease is common and is mainly noticed on leaves in the spring, or berry caps which turn tan or dark brown if wet. Some of the newer varieties ('Flavorfest', 'Liz', 'Rocco', 'Keepsake') appear to be quite susceptible. This disease can be differentiated from fungal leaf spots by holding the leaves up to sunlight, and looking for blocky areas of leaf tissue that are lighter in color, giving the leaf a "stained glass" appearance. Infected tissue eventually dies, and when dead areas coalesce, this disease can be mistaken for large leaf spots like those caused by Neopestalotiopsis.

Powdery mildew. This disease isn't typically a large concern in itself, but has sometimes been severe enough in the fall to cause large areas of leaf tissue to die, causing growers to think that they had a different disease. It first causes the edges of the leaves to curl inward, and reddish flecks appear on the upper leaf surface. 'Galletta', which is resistant to Neopestalotiopsis and anthracnose, is especially susceptible to powdery mildew.

What to do? First, inspect plug plants when you first receive them, and if plants look weak, cut through the crown top to bottom and look for brown or reddish-brown discoloration. This alone won't tell you which disease you might have, but by putting this symptom together with other ones (leaf lesions or petiole lesions or lack thereof, variety being grown) you might be able to make a good guess.). Second, avoid planting suspicious plants to the extent that you can. It usually is a good idea to order some extra plants so you don't feel like you need to plant every last one. Third, trim off dead leaves and runners to help to keep any diseases from being splashed onto healthy tissue by rain. Finally, consider application of an effective fungicide if needed. If phytophthora crown rot (or root rot) is suspected and has been a problem in the past in your field, an application of mefenoxam (Ridomil Gold SL and others), metalaxyl (MetaStar 2E), or oxathiopiprolin plus mefenoxam (Orondis Gold Premix) through the drip system 15 days after planting, possibly with follow-up foliar applications of fosetyl-Al (Aliette WDG) or a phosphite product (Phostrol, Prophyte, etc.) may be considered. If anthracnose crown rot is suspected, captan and Switch have good efficacy and should be applied 2 or 3 times during the fall, being sure to get good coverage into the crown area. There is a considerable amount of resistance in anthracnose to category 11 fungicides. It is more important than ever to select your fungicide sprays wisely and rotate among chemistries to avoid control failure. Thiram and Switch have partial efficacy against Neopestalotiopsis, while other fungicides have little effect. Because angular leaf spot is caused by a bacteria, fungicides have no effect, though copper sprays can be used to protect foliage and caps from bacterial splash during rainy conditions or during overhead frost protection use. Powdery mildew requires specific fungicides with effectiveness, but these usually are not necessary. Follow your state's regulations regarding which products may be used on your farm.

RECENT ADVANCES IN STRAWBERRY NURSERY PRODUCTION

Edward Durner
Associate Research Professor
Plant Biology
Rutgers Specialty Crop Research and Extension Center
283 Route 539
Cream Ridge, NJ 08514

Peter Nitzsche
County Agent I / Professor
Department of Agriculture and Natural Resources
Cooperative Extension of Morris County
P.O. Box 900
Morristown, NJ 07963-0900

durner@sebs.rutgers.edu
nitzsche@njaes.rutgers.edu

This work is supported by Specialty Crop Research Initiative (SCRI), Grant no. 2021-51181-35857, Project accession no. 1027418, sponsored by the USDA National Institute of Food and Agriculture.

Rutgers University recently received a USDA Specialty Crops Research grant ("Development and Integration of Next-Generation Propagation Strategies to Enhance the Resilience of the US Strawberry Supply Chain" (SCRI Grant no. 2021-51181-35857)) as part of a large nationwide effort to improve the sustainability and stability of the strawberry nursery industry.

The US strawberry industry is large with a farm gate value over $2 billion. Most strawberries in the US are produced in annual plasticulture, relying heavily on a consistent supply of healthy, productive plants from nurseries in California, North Carolina and Canada. These nurseries are highly specialized, often producing more than one billion plants each year generating $200 to 300 million additional value to the strawberry industry overall. Most of the nursery plants are produced in open fields, making strawberry transplants potential carriers of devastating plant pathogens (*Macrophomina* root rot, *Phytophthora* crown rot, *Botrytis* fruit rot, anthracnose, angular leaf spot and *Neopestalotiopsis* fruit rot) any of which may become apparent in the production field leading to significant production losses.

Anticipating the possible phase-out of Methyl Bromide (MB) (used for nursery field disinfestation), the emergence of new nursery borne diseases and the development of pesticide resistance in currently known pathogens, a major USDA Specialty Crops Research Grant with North Carolina State University as the lead institution was awarded to address this problem.

This grant for $5,294,195 over 4 years is investigating the emerging technologies in controlled environment agriculture to develop a system for propagation of disease free strawberry transplants. These technologies may also ease other challenges in the strawberry nursery industry. They could reduce the duplication of infrastructure, equipment, labor and transportation associated with running a strawberry plant nursery

at multiple locations thereby reducing the operating costs of such nurseries. In addition, these technologies could improve propagation rates, increase uniformity in propagation and enhance fruiting performance. We anticipate that through this highly collaborative, coordinated and systematic approach we will be able to develop optimized, clean propagation techniques, using CE practices and genetic tools and deliver technology that eventually reduces disease incidence, improves propagation efficacy and transforms the entire strawberry industry.

One of the main research objectives at Rutgers (Durner) is to evaluate new technology (mono-chromatic LED lighting) effects on flower, runner and branch crown development in plug plants. The idea is to take a single crown plug plant (which would eventually be planted into plasticulture, high tunnel or greenhouse production) and determine if we can regulate its development with LED lighting during the propagation stage. For example, is there a specific wavelength which will keep long-day cultivars vegetative so that the plug can become larger and well-established before it flowers? Inflorescences are often removed from long-day cultivars such as 'Albion' for several weeks after planting, thereby increasing labor costs. Is there a wavelength we can use to encourage branch crown development in a short-day cultivar followed by a wavelength to encourage flower bud development to produce a 'production-ready' plug plant with 5 or 6 branch crowns for the greenhouse or field? This would greatly lessen the sensitivity to planting date in the plasticulture system. Plants need to develop 4 to 6 branch crowns before forming flower buds in the fall. Plant them too early and too many branches will form resulting in significantly smaller fruit. Plant them too late, and not enough branches will form leading to significantly reduced yield per plant.

Rutgers (Nitzsche) is also responsible for development of services and products, extension and outreach activities to industry and public stakeholders. These materials include: a project website and blog; newsletters and public relations; strawberry propagation guidelines and recommendations; educational video series and webinars; regional and national field days; development of Spanish outreach material to reach a broader audience; development of an international conference on CE propagation and production technology; and in-service Train the Trainer education.

At the end of this project, the US strawberry industry will possess the technological and economic knowledge, as well as the capacity to use new technology and CE strawberry propagation tools to cost-effectively produce clean strawberry transplants.

Agriculture Technology I

BENEFITS OF PlantTape FOR VEGETABLE GROWERS

Dominick Levari – Excepts from Company Website
East Coast Manager – PlantTape
levarid1@tcnj.edu
https://www.planttape.com/

PlantTape enables fast transplanting. A crew of 3 (including the tractor driver) can transplant 2-5 acres of onions, cabbage, broccoli, or other vegetables per hour. Compared to other transplanting systems with a 15-person crew, PlantTape reduces vegetable transplanting labor requirements by 80%—while increasing transplanting productivity and crop yield.

PlantTape's automatic transplanter allows for extreme granularity and control in plant-to-plant and line-to-line spacing. The PlantTape 3-point automatic planter was designed by farmers, for farmers. Growers can adjust line-to-line spacing in the field, using simple tools. Similarly, planter modules can be added or removed to allow for almost any bed configuration.

Where other vegetable transplanters might give you stepwise plant-to-plant adjustments (say every 2 inches in a 12"-24" window), PlantTape allows precise plant spacing adjusted in quarter inch increments. Operators simply configure or change the plant spacing via a touchscreen on the side of the transplanter. Operators configure plant spacing via a touchscreen console and can even change it on the fly. It's easy to switch from planting onions at 3.5" to 4.25" with a simple click of a button.

The PlantTape system is adaptable and has been used on a wide variety of crops, from brassicas to iceberg lettuce to hemp and tomatoes. For farms that grow multiple commodities on a large scale, PlantTape's versatility allows them to harness our system across different crops with minimal reconfiguration effort.

Healthier Plants: Root Benefits Stronger root architecture
Conventional vegetable transplants grow in a containerized soil plug that forces the roots to grow in a tight ball. Once transplanted, the conventional seedling undergoes significant transplant shock while the roots untangle themselves and grow into the surrounding soil.

The PlantTape difference
PlantTape transplants grow in an open-bottom plug that encourages a natural root architecture that quickly grows downward and outward to establish the plant in the soil. PlantTape's open-ended plugs allow the actively growing, viable roots to explore a wider range of soil. They can then form a stronger fibrous root system by tapping into more nutrients.

Reduces vegetable transplant shock
PlantTape reduces transplant shock to vegetable seedlings because the transplanter pulls the tape from the nursery trays, cuts the tape, and places each transplant—still in its paper encapsulated plug—into the ground without ever touching the plant.
No manual handling of seedlings, no trauma from being uprooted.

Biodegradable Plant Tape
Our trademark plant tape material is what enables our entire system, from sowing **through** transplanting. The tape is biodegradable, which is one of the key factors in allowing the PlantTape automated transplanting system to be such a game changer. Because the tape can go directly into the soil, the plant is never touched during planting. Once in the ground, the tape is still visible if a plant is uprooted from the ground. However, after the field is harvested and the remaining plant material is disked back into the soil, the tape will disintegrate over time among the other organic matter.

Precision Planting for More Productive Stands PlantTape's planter modules are driven by a hydraulic system. The hydraulic drive allows consistent spacing, even in challenging conditions, unlike chain-and-sprocket ground-driven transplanters that often slip or skip plants in sandy or slick soil.

Calibrating Planting Modules to Ground Speed The PlantTape transplanter's computer system ensures that each seedling is placed into the soil with the utmost precision. A wheel tracks fluctuations in ground speed and the computer calibrates the speed of the transplanter modules to ensure that plant-to-plant spacing remains consistent whether the planter is going 2 miles per hour or 5 miles per hour (note that we've successfully proven our transplanter at 20mph, though we don't recommend going that fast for production planting).

Greater Granularity in Plant Spacing PlantTape's easy to use computer system enables adjustment of plant-to-plant spacing in quarter-inch increments. this increased granularity gives more precision to growers, allowing them to experiment and fine-tune planting stands to perform and grow best in their local conditions.

As a result, PlantTape crops often have higher-quality stand counts which then results in a better crop yield. As with nursery productivity, growers often achieve higher productivity out of equivalent acreage by adopting PlantTape for vegetable, tomato, and hemp transplanting.

PlantTape, the leading provider of an automated transplanting system and Stokes Seed, a renowned seed company, are excited to announce a dynamic new partnership aimed at delivering exceptional service to their grower customers. In an effort to provide growers with the best possible resources, PlantTape has decided to collaborate with Stokes Seeds, making them the recommended seed supplier for PlantTape customers across the eastern regions of the United States and Canada.

BIODEGRADABLE MULCH AGRICULTURAL EXPERIENCES – A FARMER PANEL

William Sciarappa, Ag Agent – Rutgers University, Stephen Specca, NJ Grower

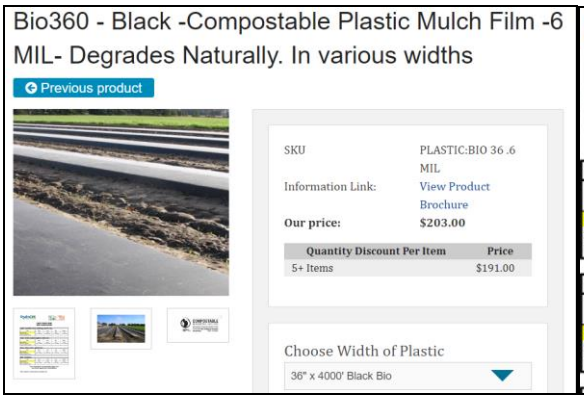
Our session in New Agricultural Technology allows growers to share their commercial, crop and cost experiences with both conventional non-biodegradable polystyrene and upcoming biodegradable plant-based plasticulture types. Audience participation is encouraged, and a short survey may be distributed for more feedback. Initial topics should primarily cover comparisons of cost, coverage, crops, and crop growth and then briefly move into observations and measurements of weed management, soil chemistry, rhizosphere biology, leaf photosynthesis, biomass, fruit yield, product durability and disposal. Currently costs may be changing, a brief online search of a few plasticulture products shows 2024 purchase of five rolls of 4000' length by 48" width with generally 1.0 - 1.5 ml thickness as follows.

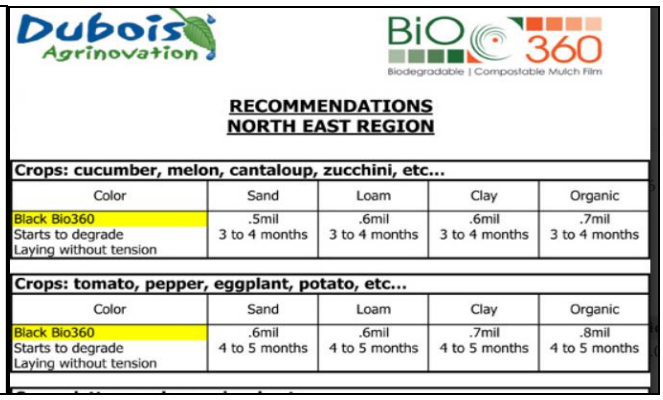
- Standard Poly – various manufacturers/distributors from about $ 230 to $264 per roll.
- BIOGold – by BioFlex/Filmtech - feedstock materials of PLA/co-polyester costs $ 209.
- BIO360 - by Mater – with feedstock of a plant starch and PBAT costs $ 191.
- Radical Plastics – older poly formulation with transfer food for microbes is about $ 300.

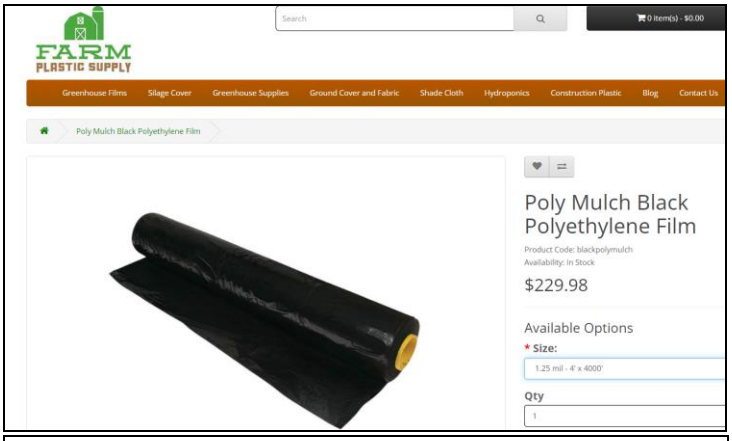
In NJAES Farmwork, replicated research trials were conducted at both Rutgers Hort Farm 3 in 2022 and 2023 at Ryders Lane, New Brunswick and the Specca Family Farm in Bordentown. Comparative results in Habanero peppers for foliar efficiency, total crop biomass, fruit yield and soil health have similar trends of biodegradable plant-based resin materials to standard non-degradable plastics which show similar foliar chlorophyll ratings but slightly higher crop biomass and fruit yields, and better soil microbial populations for the both types of biodegradable plasticulture materials. Capsaicin analysis among the fruits of four habanero cultivars were initiated after 10 days of desiccation showed little difference in regards to planting on either biodegradable versus non-biodegradable plasticulture.

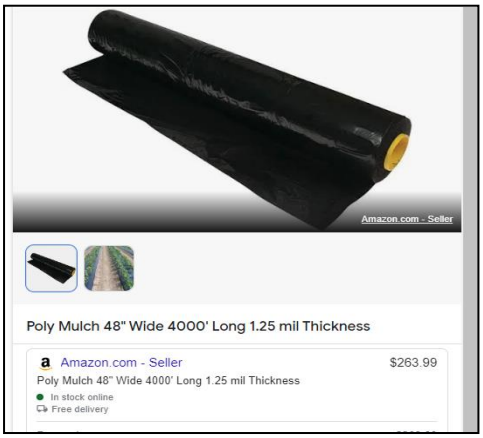
Durability/resistance to piercing, tearing & ripping of the three bio-plastics was almost as good as standard polyethelene. In 2023 trials versus 2022, the BioGold remained as good as poly but a change in the formulation of the two experimentals increased to degradation faster leading to significantly more damage in a more severe wind and hard rain season. In regards to plastic pieces and microplastics, soil sampling at 0-8" depth was done 5 and 10 months after harvest in 2022-23. The standard plasticulture covering was removed soon after harvest and disposed of in a landfill and had moderately high levels of micro-plastics. Biodegradable materials had been cultivated into the soil showed higher levels of plastic pieces and microplastics in polyethylene plastic. BioGold biodegradable had low amounts of micro-plastics compared to low or non-detectable microplastic amounts of new experimental plant-based mulches of Radical Plastics.

ONLINE SURVEY OF CONVENTIONAL NON-BIODEGRADABLE & BIODEGRADABLE PLASTIC MULCH ADS









BIOGold Black Embossed Biodegradable Film

$208.63

SKU: BBF45
Weight: 960 oz.
Category: Mulch Plastic

It looks and lays like standard mulch plastic . No special laying instructions . No special storage instructions . **BioGold** relies on the microbes in the soil to biodegrade the plastic . **BioGold** is light and heat stable . **BioGold** is designed for one crop . After harvest, just disc **BioGold** into the soil. **BioGold** will continue to biodegrade until just soil is left . Save time, labor and the enviroment . 4' x 5,000' x 1 Mil

RADICAL PLASTICS SUPPLY
4000' X 36-48" 1.25 ML.
$249-$359 PER
ROLL

Ken-Bar products for the grower

ACKNOWLEDGEMENTS TO: Radical Plastics - Dr. Yelena Kann, and Charles E. & Lena Maier Grant from NJVGA and NJAES

Organic

THE WHEN & WHY OF ORGANIC CERTIFICATION

Devin Cornia, Executive Director
Northeast Organic Farming Association of New Jersey
386 Rock Road East Lambertville, NJ 08530
devin@nofanj.org https://nofanj.org

The decision to pursue organic certification is full of nuance and is certainly not a one-size-fits-all endeavor. Producers, processors, handlers and distributors must take into consideration various opportunities, challenges, contexts, and timing to determine whether certification is appropriate for their operation at any given time.

Primarily, producers choose to become certified organic to increase their access to opportunities in the marketplace. Organic is the fastest-growing sector of the U.S. Food Industry, breaking the $60 Billion threshold in 2022 1 . Consumers seek out the USDA Certified Organic label online and in-person at retailers, community farmers markets, and other businesses, as the NOP (National Organic Program) organic label represents a convergence of many values that drive consumer spending. These values include, but are not limited to, product transparency, ecological stewardship, humane treatment of livestock, fair labor practices, and climate-smart production practices.

Further, producers should take note of opportunities in the organic marketplace. The Organic Trade Association's 2017 U.S. Families' Organic Attitudes and Behaviors Study captured data on "generational buying habits of U.S. households and found that Millennial parents – parents in the 18- to 35-year-old age range -- are now the biggest group of organic buyers in America... Millennials are the largest consumer group in the United States, and they're choosing organic." Organic foods are not just for specialty stores and farmers markets, either. Conventional grocery retailers have overtaken natural food stores as the most popular outlet for organic food, with 55.6 percent of sales in 2021. 2

Upon accessing appropriate markets, Certified Organic operations can expect to earn a premium for their product compared to non-certified operations. A University of Illinois study found the "average difference in net returns to land between the organic and conventional crops was $73 per acre 3 " when reviewing corn, soy, and alfalfa prices.

Additionally, gaps in the supply chain leave many organic producers reliant on remote suppliers for certified organic livestock feed, crop seed, and hay/silage, presenting additional opportunities in the marketplace. As a result of NOP requirements, producers are required to maintain thorough recordkeeping, which can be both a challenge and a benefit to the management of the business. Also, grants and funding opportunities for organic operations continue to increase and the cost-share for certification reimbursement offered by the USDA is now up to 75%, easing the financial burden of certification.

All things considered, it is important to note that the interpretation of USDA NOP regulations has allowed corporate interest and industrial-scale farming to "pressure-test" the ideals and underlying principles of organic farming, and this exploration of organic certification would be remiss not to mention that there are imperfections within the regulations. Acknowledging this leads to another significant motivation for certification:

organic farming as a “movement”. Many producers opt to certify to bolster the organic farming community’s ability to advocate. For many, becoming certified allows producers to represent their belief in and support of organic farming principles. As more farms become certified organic, a stronger case can be made for additional resources and support for organic food systems.

On the other hand, there is a time and a place where organic certification may not be the recommended course of action. Most obviously, producers or handlers that experience less than $5,000 in sales do not need to go through the certification process (but are not allowed to use the Certified Organic logo in their marketing). Farms operating without long-term land security might not want to pursue and incur the costs of organic certification. Also, transitioning to organic should not be seen as a way to “save the farm”... despite the promise of increased yields, conventional producers who opt to transition should be equipped with the technical support and financial security to endure initial reductions in yields and higher labor costs as organic production methods are introduced. Finally, many producers in NJ benefit from robust direct-to-consumer sales, opting to have “conversations” instead of certifications, whereas farms without direct relationships to their customers might opt to become certified to ensure trust with the consumer.

For beginning farmers just starting out, participating in the process of becoming certified organic can serve as a useful tool in establishing a farm plan, establishing record-keeping systems, attracting retail customers as well as accessing wholesale markets, and ensuring the long-term stewardship of their land and ecology. Existing farmers should first take into consideration the many variables and associated benefits, challenges, and opportunities that come with certification and then formulate a transition plan that makes sense for the farm and for the farm’s bottom line.

Further Resources:
1 USDA AMS Weekly Retail Price Comparison (April 2022)
2 USDA ERS: "Rising Consumer Demand Reshapes Landscape for U.S. Organic Farmers"
3 University of Illinois at Urbana-Champaign: "Conventional and Organic Enterprise Net Returns"
USDA Fact Sheet: "Do I Need to be Certified Organic?"
MOFGA "Why Become Certified Organic"
Organic Trade Association 2023 Industry Survey

ORGANIC CERTIFICATION; PROCESS AND PREPARATION

Erich V. Bremer
Supervisor Organic, Sustainable, and Regenerative Agriculture (OSRA) Program
New Jersey Department of Agriculture
PO Box 330
Trenton, NJ 08611
(609) 913-6505 (v)
(609) 984-2508 (f)
erich.bremer@ag.nj.gov
https://www.nj.gov/agriculture/divisions/md/prog/jerseyorganic.html

Farmers and gardeners interested in organic certification can feel overwhelmed at the start of their journey. While trying to get prepared on the ground to begin organic production, a long set of regulations now comes into play filled with legalese and new terms. Then a large packet of forms from the certifier arrives. This can make the task of getting certified seem daunting. You do not have to go through this process alone. The NJDA Organic, Sustainable, and Regenerative Agriculture (OSRA) program can help you get through the initial aspects of organic certification.

As with most things in life, consideration and planning is key to moving forward with the least amount of stress and time wasted, which no farmer can spare. Taking a step by step measured approach and prioritizing tasks will be advantageous.

Healthy soil is number one. Whether you have a part-time small market garden selling vegetables to the neighbors, or a larger production farm selling wholesale, building a healthy diverse soil base and shoring up the natural infrastructure of the farm's ecosystem will be critical. Organic systems rely on healthy, diverse soils and a diverse farm ecosystem to keep pests and diseases in check, and to supply crops with sufficient fertility for abundant production. The NJDA's OSRA web page has sources of information and links to organizations who can help you educate yourself on the best methods to quickly build soil health and biodiversity on your farm.

Learn the basics of the regulations so you can consider all factors while planning your organic production. The NJDA OSRA program can help guide you through the regulations and answer any questions you may have concerning their requirements.

Know before you hit go! Have a good idea of exactly what you will be growing and how before you begin to interface with an accredited certification agent. The agent will need to know exactly what you will be growing, where you will be growing it, and how. You will also need to explain things such as your plans for crop rotation, cover cropping, and other methods used to supply fertility, prevent erosion, and provided for pest control. You will have to describe these things in your "organic system plan". An organic system plan is typically generated by completing the forms sent by the agent. Don't make it any harder than it needs to be initially. Get down the information for the things you KNOW you will be doing initially, and don't worry about things that may be a season or two away from happening. You can add to your organic system plan and expand your operations to add production areas and new crops/livestock products in the future. Keep

in mind you will be required to update your organic system plan each year and undergo an inspection annually once certified. The update period is the best time to report changes and get inspections on any new facets of production.

Don't make a mistake with chemicals or materials while you transition. Fields where organic products are harvested must be free of "prohibited materials" for thirty-six months (3 years) prior to harvest. Once applications of unapproved fertilizers and pesticides have ended it is important not to introduce any prohibited materials to the area that would reset the transition clock. It is not always obvious if something can or can't be used. If you are not 100% sure of a material's allowed status you should check with someone who is knowledgeable, such as an accredited certifier (the one that you will be seeking certification from). Don't rely on word of mouth from other growers who may or not be certified themselves. Find an experienced decision maker. The OSRA program can help you identify which materials would be allowed or prohibited and can teach you how to make these determinations and document compliance.

Once you have a pretty good idea on what, where, and how, it is time to choose which accredited certification agent to work with. There are over a dozen agents currently serving NJ. Some are larger for-profit operations who are international in scope, and some are smaller nonprofits who only do regional work. The NJDA OSRA program can help you identify agents who would be a good fit for you and your operation.

You will be submitting your organic system plans and associated forms to the certification agent. They will review what you have submitted to ensure there are no major noncompliance preventing certification. If all is in order an organic inspector will interface with you to set an appointment for your inspection. Be sure you have all your documents in order and ready for review by the inspector on inspection day. This includes your copy of the submitted organic system plan. Be prepared to spend most of, if not all day, on your initial inspection. The NJDA's OSRA program can help you learn what the inspectors will be asking to look at and what is expected of you for this initial inspection.

Once the agent receives your inspection report they will do a review of your plan and the report to make the certification decision. Organic certification is not a pass or fail event. One possible outcome could be that everything is in order and certification can be granted right away. Often there are minor problems, a "minor noncompliance" where you will need to make some adjustments prior to receiving certification. You could receive an official "Notice of Noncompliance" if not meeting, or if violating, one of the regulatory requirements. In this instance you will be given time to respond and adjust your organic system plan. You will need to explain how the noncompliance would be avoided in the future in your response.

Once you become certified your organic certification remains in effect until it is surrendered by you, unless suspended or revoked by the agent. You will be required to do an annual update and undergo an annual inspection to maintain certification.

The NJDA's OSRA program is here for you for all matters concerning getting and maintaining organic certification. You can easily find us by putting "NJDA Organic" into any search engine or by calling (609) 913-6505.

Nursery and Ornamentals II

WHOLE NURSERY PESTICIDE REGIME CONSIDERATIONS

Tim Waller
Agricultural Agent
Cumberland Cooperative Extension
291 Morton Ave.
Millville, NJ 08332
twaller@njaes.rutgers.edu
https://plant-pest-advisory.rutgers.edu/category/landscape-nursery-turf/

Designing a pesticide regime must consider numerous factors that target both anticipated and perceived threats to plant production. This can seem overwhelming and lead to the use of more, or less, materials than are required to solve a particular suite of pest issues. Chemical use does not guarantee complete pest management, rather incorporation of pest awareness, historical information, cultural practice modifications, chemical mobility and application understanding, and ultimately lifecycle information culminate towards successful regime implementations. Ultimately, what are the targets, and how do the tools available work towards alleviating these issues, is central.

To address the steps taken towards regime design and implementation a series of questions must be considered. Gathering knowledge about these issues, especially when they are critically treated for and what they look like in advance will give an applicator more control than simply “spray and pray”. The below topics offer a stepwise approach that build upon each other to deliver acceptable pest management levels, while using the least, and least expensive materials that provide the safest working conditions and greatest ecological stability.

1. **What are the pest issues I am trying to mitigate?** Pest here refers to insects, arachnids (particularly mites), diseases, and weeds. Understanding where these pests overlap in management timeframes greatly aids in increased efficacy per management pass. Keeping good logs of this information year over year will greatly aid in troubleshooting why this issue has been a regular problem. Another key factor is determining if they are part of a quarantine or actionable pest list as this can greatly impact overall regime design.

Insect and arachnid pests - How and where do they feed- chewing, sucking, underground etc.? What is their lifecycle, when is the most important management timeframe, what do they look like at the critical control window? The Rutgers Pest Scouting Guides – Scouting with Growing Degree-days (LONT and Conifer versions) are great tools for this application. Does the pest migrate into the production area or overwinter in place? Are we moving them throughout the production area?

Diseases - Has this disease been a problem before, which years or seasons? What is the host range of the disease? Many diseases have narrow host ranges, others not. What is their lifecycle, does this overlap with other regularly managed diseases? Note many diseases are active near bloom times, again in the summer near drought or flood conditions, and again as the winter season approaches. Are they part of a quarantine?

Ex. Boxwood Blight necessitates a dynamic cover spray approach which may cover other diseases in the production area (ex. broad spectrum Chlorothalonil).

Weeds – Where are they most prevalent- everywhere, greenhouse / prop. area, in hoop-houses? Have control measures failed previously? What is their lifecycle – how are they spread? What is their point of entry into the production system? Have you experienced phytotoxicity in host crops with specific herbicides, can I use rice hulls?

Perceived threats – all pests, diseases, and weeds will not be present every year, or hopefully ever on a nursery. However, given the movement of invasive insects, actionable disease, and herbicide resistant weeds a regime should always account for the potential of these perceived threats. For example, if boxwoods are critical to an operation, proactive cover sprays that treat for boxwood blight would be warranted even if the disease has never been identified in that area to safeguard devastating losses.

2. **What materials do I have or need?** Selection is principally addressed by understanding the spectrum of activity per material (what is the range of pests mitigated and labeled for on a particular material) and whether this lines up with actual and perceived pest threats within the management area or crop type. Additionally, how these materials move and how they can be applied is critical when implementing a management regime. For example, if white grubs or root diseases are the target a material must either be amphimobile (xylem and phloem), phloem mobile, or be delivered directly to the root system through a drench, 'sprench', or basal bark spray. Residuals (how long does the material last, and through what conditions) and the worker reentry intervals (REI) also play a practical role in chemical selection. For all materials pesticide resistance should be managed through rotations of groups (FRAC, IRAC, HRAC) and the use of multi-site pesticides that act to clean up potential resistant populations. Remember spray by the numbers to avoid pesticide resistance.

Mobility of materials / translocation:

Contact materials – non-systemic insecticides (ex. carbaryl), protectant fungicides (ex. chlorothalonil), burn-down herbicides (ex. fatty acids). These materials are non-mobile within plant tissues and are typically fast-acting and are often formulated with spreader-stickers to prolong their residual activity. This residual activity can be greatly decreased by rain or irrigation events that effectively wash off the material or rapid plant growth that effectively dilutes the coverage area.

Translaminar systemic materials – many pesticides offer some level of translaminar mobility meaning the material moves from the surface of the plant (where it may or may not be toxic to pests) into the plant tissues to allow for a reservoir of toxic compounds and often protects both top and bottom surfaces of foliage. These materials can have longer residual periods, however, are not translocated to new growing areas, or areas missed by applicator error. Given these materials are not readily translocated far distances, complete coverage is essential.

Xylem mobile systemic materials – imidacloprid containing insecticides that primarily moves upwards in plant tissues (xylem), many root disease treatments (ex.

mefenoxam), and most herbicides. These materials often take longer to realize pest control yet have very long periods of residual activity (weeks to months). The residual activity again is subject to dilution through vigorous plant growth but will be translocated at some level to actively growing regions. Xylem mobile systemics are often confused with complete systemic activity which is only observed with phloem and amphimobile (bi-directional) movement as described below.

Amphimobile and **Phloem mobile systemic** materials – Amphimobile materials are rare, especially within fungicides, however the phosphonate group of fungicides [P07] move in both the xylem and importantly the phloem towards the root systems. Many more herbicides are phloem mobile, with notable examples within the Group [4] (Auxin Mimics) 2, 4-D and Dicamba. Some insecticides can also be translocated through the phloem such as Thiamethoxam, which is notably different that imidacloprid which is translocated within the xylem, even though both are Group [4a] materials.

How will these materials be legally applied; do I have the equipment to apply them? Understanding how any pesticide moves, or does not move, in plant tissues is critically important to how a pest will be controlled. Delivery methods are predicated on this, for example if a xylem mobile root disease material is used, the root systems must be targeted as xylem mobile materials will not translocate to the root system. Another example, if a translaminar insecticide is used, the material must be reapplied to actively growing areas as the material does not translocate along with the growing region. This can greatly inform if a material should be chemigated, drenched, foliar applied, top dressed granular, etc. however, the label must clearly state application method - **The Label is The Law.** A question one should ask is how will effective delivery change my regime, i.e., can less application frequency lead to greater control with proper delivery?

What are my worker safety and harvesting needs? All materials have different timeframes for reentry (REI) and personal protective equipment (PPE) that must be followed. In some cases, it may be advisable to use a material with a longer REI if that material has proven success with a given pest, i.e., managing wants versus needs for a particular pest issue. PPE should always be top of mind for all potential handlers and those designing the application regimes. We are after all talking about materials designed to kill (-cides). In some cases, a production technique such as granular incorporation into the potting process may alleviate pest pressures but will certainly increase potential exposure risks, therefore must be carefully considered.

Information is the key first step in designing or updating a pesticide regime.

Blueberry

CURRENT RESEARCH ON BEETLES AND FLIES

Cesar Rodriguez-Saona, Robert Holdcraft, and Beth Ferguson
Rutgers P.E. Marucci Center
125A Lake Oswego Rd.
Chatsworth, NJ 08019
crodriguez@njaes.rutgers.edu, rob.holdcraft@rutgers.edu, beth.ferguson@rutgers.edu
https://sites.rutgers.edu/cesar-rodriguez-saona/

Plum curculio (PC) and spotted-wing drosophila (SWD) are significant insect pests affecting highbush blueberries in New Jersey, USA. They attack the fruit during the green and ripening stages, respectively, presenting distinct challenges for effective pest management. PC adults are active during bloom, a period when insecticides for their control are restricted. On the other hand, SWD is a challenging pest because it has a high reproductive capacity, has multiple generations per year, and lacks effective biological control agents in the invaded regions. In this study, we evaluated the efficacy of a new (unregistered) insecticide against these two important pests of blueberries.

INSECTICIDE TRIAL AGAINST PC

This experiment tested the efficacy of an unregistered insecticide, Verdepryn 100SL, and Imidan 70WP (grower standard) against PC on highbush blueberries in New Jersey. The experiment was conducted in a blueberry field (var. 'Duke') located at the Rutgers P.E. Marucci Center in Chatsworth, New Jersey. Each treatment was repeated on five individual bushes in a randomized complete block design, with each bush considered a replicate. Insecticide treatments were a) unregistered insecticide at 1.03 floz/ac, 1.54 floz/ac, and 2.05 floz/ac (+0.125% Dynamic), b) Verdepryn 100SL at 8.2 floz/ac and 11 floz/ac, and c) Imidan 70WP at 1.33 lb/ac. Control bushes received no insecticide spray. Applications were made on 21 May 2023 with an R&D CO_2 backpack sprayer, using 2-liter plastic bottles. The sprayer was calibrated to deliver 40 gal of vol per acre at 30 psi, using a single ConeJet TXVS 10 nozzle, yielding 125.1 ml (4.23 fl oz) per bush.

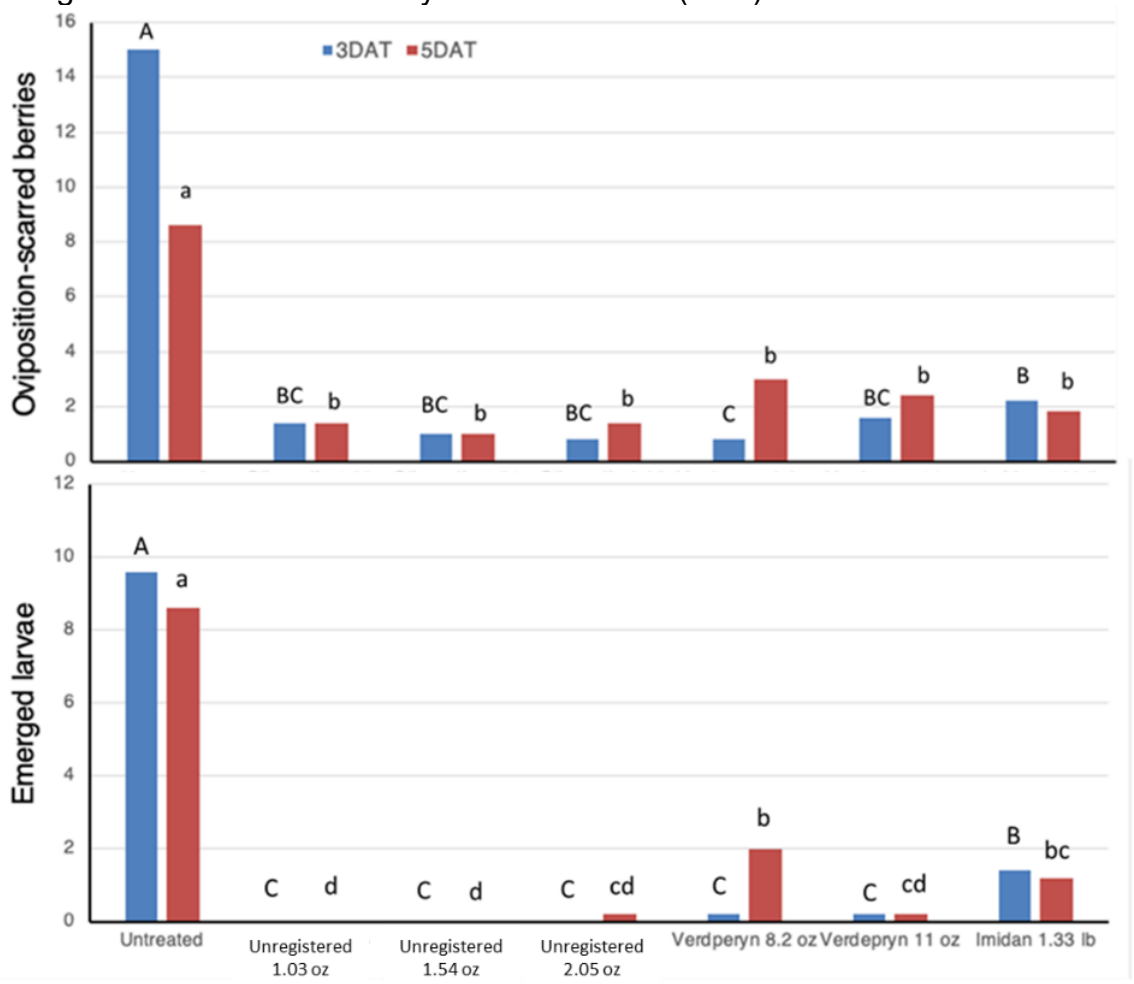
After application, a single leaf terminal (with approx. 4-5 leaves) and 30 green berries were randomly selected from the upper two-thirds of each bush within a treatment block approximately 12 hours after treatment (0 DAT) and again at 3 and 5 days after treatment (3 DAT and 5 DAT, respectively). Leaf terminals were placed in florist's water picks with an opened bottom. The tops of the terminals containing the leaves were enclosed in assay containers consisting of a ventilated 32-oz plastic deli cup with a hole cut in the bottom; the florist's water pick was fit tightly through the hole. The cut ends of terminals inside the water picks were placed in water-filled trays.

Five containers were set up for each treatment on each sample date, with the terminal and berries in each container from a separate bush (replicate). Fifteen undamaged green berries (obtained from corresponding treated bushes) were placed loosely in the bottom of each container before PC adults were added. On 22 May (0 DAT) five field-collected PC were added to each assay container, approximately 12 hours after treatment application. This sampling and assay setup was repeated on 24 May 2023 (3 DAT), and on 26 May 2023 (5 DAT).

The number of PC alive, moribund, or dead was recorded was assessed at 24 h, 72 h, and 120 h after setup (i.e., time of PC exposure to treated foliage and fruit) and their percentage was calculated for each assay container. After the last adult mortality evaluation (at 120 h on day 5), all berries were removed from assay containers and evaluated for oviposition scars. Berries were then placed in ventilated 8-oz deli cups on cotton pads and incubated on a lab light bench (23°C and 14:10 L:D cycle) for 20 days before being evaluated for presence of emerged larvae. Total number of fruit, number of scarred fruit, and number of emerged larvae were recorded and their percentages calculated.

All insecticides (unregistered, Verdepryn, and Imidan) increased adult PC mortality at 0 DAT; however, compared to the unregistered insecticide and Imidan, Verdepryn had a slower acting effect, achieving high mortality only 5 days after exposure. At 3 DAT and 5 DAT, the unregistered insecticide and Imidan continued to have a strong effect on adult PC mortality (95-100%), while the residual effect of Verdepryn on adult mortality decreased. All three insecticides significantly reduced PC fruit infestation (Fig. 1).

Fig. 1. Effects of insecticides on number of oviposition-scared berries and number of emerged PC larvae 3 and 5 days after treatment (DAT)



Different letters indicate significant differences among treatments.

INSECTICIDE TRIAL AGAINST SWD

The objective of this experiment was to determine the efficacy of an unregistered insecticide and Imidan 70WP (phosmet) (grower standard) for controlling SWD on highbush blueberries var. 'Bluecrop' in New Jersey. The experiment was conducted at the Rutgers P.E. Marucci Center, with each treatment applied to five bushes in a randomized complete block design, with each bush considered a replicate. Applications were made with an R&D CO_2 backpack sprayer, using 2.0 L plastic bottles. The sprayer was calibrated to deliver 40 gal of volume per acre at 30 psi, using a single ConeJet TXVS 10 nozzle, yielding 125.1 ml (4.23 fl oz) per bush. Insecticide treatments were: two rates of the unregistered insecticide, applied at 1.54, and 2.05 floz/ac (+0.125% Dynamic), and Imidan 70WP at 1.33 lb/ac. Treatments were applied on 30 June 2023. Control bushes received no insecticide spray.

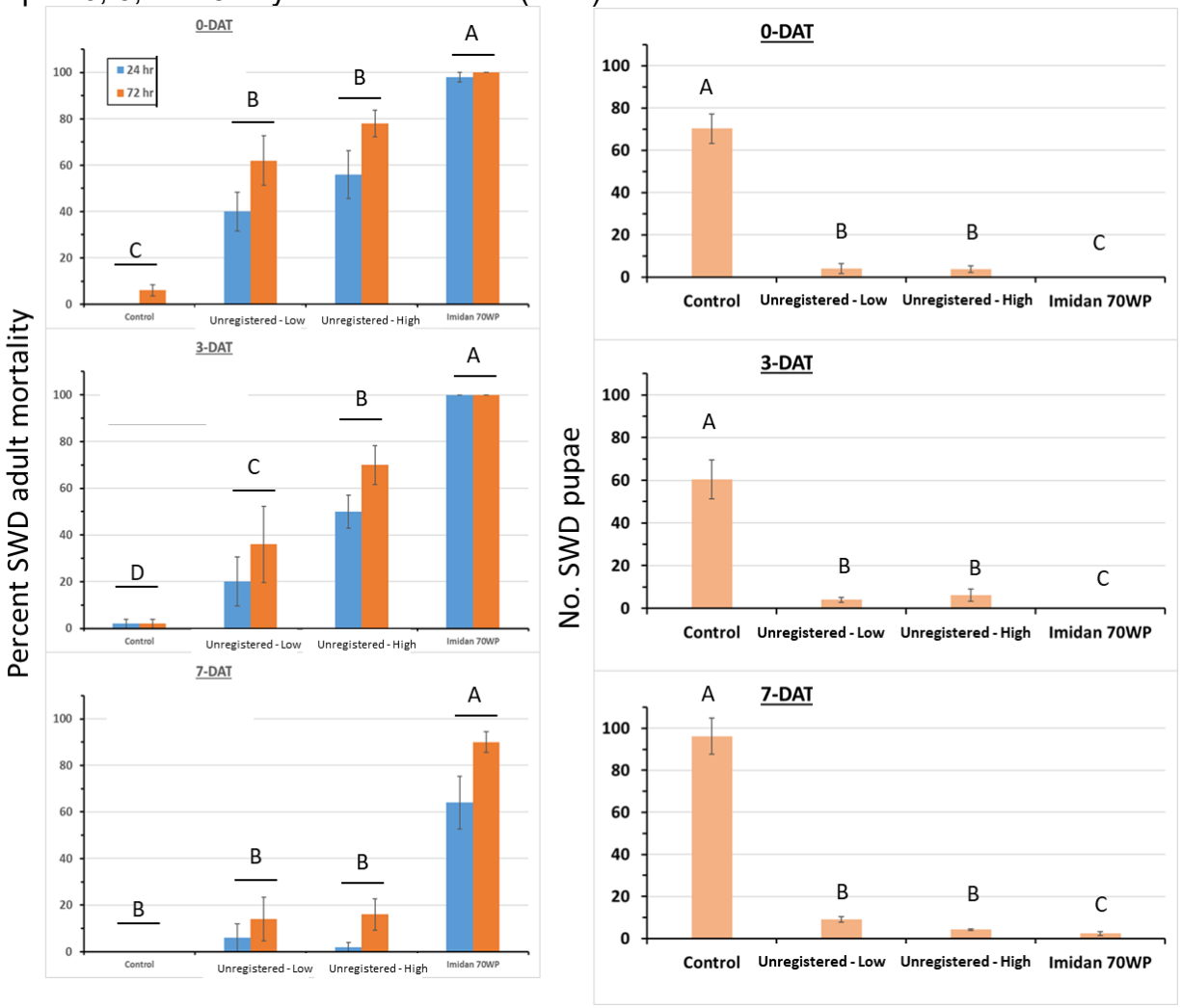
Terminals (stems with 4–5 leaves) were taken from each bush, along with 15 ripe blueberries, within 5 hours of treatment (0 DAT), and again three and seven days after treatment (3 DAT and 7 DAT, respectively). Samples were taken on 30 June (0 DAT), 3 July (3 DAT), and 7 July (7 DAT). The terminals were placed in florist's water picks with an opened bottom. The tops of terminals containing the leaves were enclosed in assay containers consisting of a ventilated 32-oz plastic deli cup with a hole cut in the bottom; the florist's water pick was fit tightly through the hole. The cut ends of terminals inside the water picks were placed in water-filled trays. Additionally, a 2-cm piece of moistened dental wick was added to each container to supply water for the flies. Five containers were set up for each treatment on each sample date, with samples from each container coming from a single bush. Fifteen loose ripe berries (obtained from corresponding treated bush) were placed in the bottom of each container before flies were added. Flies from a lab-reared colony were added to the containers within 2 hours after terminals were clipped from bushes. For each assay date, a total of 10 adult SWD flies (5 females and 5 males) were removed from the colony and released into each container. After flies were added to the containers, the containers were placed on a light bench in the lab under a 14L:10D photoperiod and were kept at ambient temperature (~25°C) during the observation period.

Adult mortality data were collected at 24 and 72 hours after exposure to the treated fruit and foliage. The number of live, moribund, and dead SWD males and females was recorded, and their percentage was calculated. Berries were removed from containers on day 3, and eggs were counted for each berry. Fruit was placed in ventilated 8-oz deli containers with cotton pads, incubated under the same environmental conditions as described above for 15 more days, and monitored for larval emergence and pupation. Pupae from the berry samples were then counted and the total number of pupae per berry was calculated.

At 0 DAT, the unregistered insecticide significantly increased adult SWD mortality but by <80%; in comparison, Imidan provided 100% mortality (Fig. 2). At 3 DAT, adult SWD mortality by the unregistered insecticide was <70% while mortality by Imidan remained high (100%) (Fig. 2). At 7 DAT, adult SWD mortality by the unregistered insecticide was low (<20%) and not significantly different from the untreated control, while mortality by Imidan continued to be high (>60%) (Fig. 2). Even though mortality was not as high as

Imidan, the unregistered insecticide significantly reduced the number of pupae that emerged from fruit at 0, 3, and 7 DAT compared to the untreated control (Fig. 2).

Fig. 2. Effects of insecticides on percent SWD adult mortality and number of SWD pupae 0, 3, and 5 days after treatment (DAT)



Different letters indicate significant differences among treatments.

Acknowledgements
We thank Syngenta and SummitAgro USA for the financial support and Jennifer Frake and Ashley Pearson for lab and field assistance.

Produce Safety

COMMUNICATING PRODUCE SAFETY: UNDERSTANDING THE LANGUAGE OF RISK

Meredith Melendez
Rutgers Cooperative Extension of Mercer County
1440 Parkside Avenue, Ewing, NJ 08638
melendez@njaes.rutgers.edu

Wesley Kline, PhD
Rutgers Cooperative Extension of Cumberland County
291 Morton Avenue, Millville, NJ 08332
wkline@njaes.rutgers.edu

Human pathogen outbreaks associated with fresh produce are a reality. Human pathogens can be transferred from one person to another through the surface of produce that is consumed raw. This is most commonly done through the fecal-hand-oral route of contamination. Scientific progress has allowed for greater understanding of the human pathogens that can be found in the farm environment, the spread of these pathogens and the potential for multiple illnesses relating to contaminated produce. Farmers are interested in producing the highest quality fruits and vegetables, and this must include understanding the human pathogen risks on their own farm and the development of risk reeducation measures. All farms have hazards, a biological, chemical, or physical agent with the potential to cause an adverse health effect. Some hazards are more likely to cause a human health risk. Risk is the probability of an adverse health effect and the severity of that effect. Each hazard identified on a farm should be considered and the likelihood and magnitude of the risk should inform the activities involving produce on the farm. The goal is to prioritize the risks that are most likely to occur and most likely to have severe consequences and implement risk reduction measures.

A risk score can be used as a tool to differentiate risks that may need to be controlled or managed. The severity of the risk can be multiplied by the likelihood of the occurrence to determine the risk.

Figure 1. Risk score decision tool

		Potential Consequences				
		Not Significant	Minor	Moderate	Major	Severe
Likelihood	Almost certain	Medium	High	Very high	Very high	Very high
	Likely	Medium	High	High	Very high	Very high
	Possible	Low	Medium	High	High	Very high
	Unlikely	Low	Low	Medium	Medium	High
	Rare	Low	Low	Low	Low	Medium

For example, a farm that has regular intrusions of birds feeding on blueberry bushes just prior to harvest would assess the likelihood of the bird fecal matter ending up on blueberry fruit (almost certain) and the severity of the potential harm (direct fecal contamination on produce typically consumed raw that would touch food contact surfaces, other berries, and many other berries) could have potentially major consequences. Based on these answers the risk would be considered very high and the farm should implement reasonable measures to reduce this risk.

Understanding commonly used terms relating to food safety on farms is important for developing and communicating your farms food safety risk reduction practices.

Hazard – A biological, chemical, or physical agent in, or condition of, food with the potential to cause an adverse health effect.

Likelihood – How likely that something will occur that could potentially cause harm.

Magnitude – The size or extent of the health hazard impacts.

Risk – A function of the probability of an adverse health effect, and the severity of that effect, consequential to a hazard in food.

Severity – The seriousness of the potential illness/human health outcome and the potential consequences.

There are many Extension based resources available to help farmers navigate food safety concepts, regulations and audits.

National Good Agricultural Practices Program, Cornell
https://gaps.cornell.edu/

Produce Safety Alliance, Cornell (FSMA Produce Safety Rule, Trainings by state)
https://producesafetyalliance.cornell.edu/

Produce Food Safety Program, University of California, Davis
http://ucfoodsafety.ucdavis.edu/Preharvest/

Rutgers Plant and Pest Advisory, Food Safety
http://plant-pest-advisory.rutgers.edu/category/commercial-ag-updates/food-safety/

Figure 1 developed by Channah Rock, University of Arizona

Workshop: FSMA PSR Grower Training

CHOOSING AND USING FOOD CONTACT SURFACE SANITIZERS

Meredith Melendez
Rutgers Cooperative Extension of Mercer County
1440 Parkside Avenue, Ewing, NJ 08638
melendez@njaes.rutgers.edu

Wesley Kline, PhD
Rutgers Cooperative Extension of Cumberland County
291 Morton Avenue, Millville, NJ 08332
wkline@njaes.rutgers.edu

There are many ways that product contact surfaces can come to harbor human pathogens. Normal production of fresh produce involves the potential for contact with soil, farm workers, harvest and packing equipment, irrigation water and postharvest water to name a few. Once contaminated these items, considered food contact surfaces, can spread the pathogen onto the produce that it touches. Contact surfaces vary from farm to farm, the easiest way to identify them is to trace produce from the field to the sales location identifying each surface along the way. Direct marketers need to consider the potential risk with pick-your-own containers, product displays, and shopping containers and bags. Product contact surfaces must be washed, rinsed and sanitized regularly to reduce the likelihood of human pathogen contamination. Surfaces that come in contact with produce must be easy to assess for cleanliness, easy to clean and easy to sanitize. This may require you to take apart the equipment, particularly if conveyers, rollers or brushes are components.

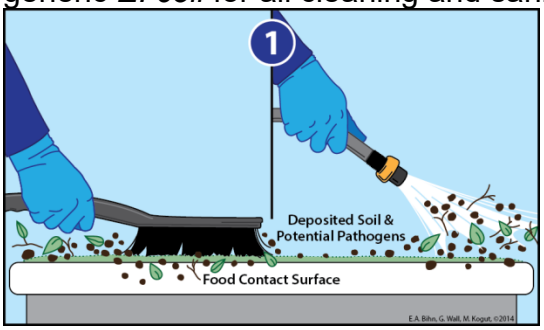
Human pathogens, such as *E. coli*, Salmonella and Listeria, can grow on surfaces when the environmental conditions are appropriate. These pathogens thrive, and reproduce, in moist conditions. Smooth surfaces are much easier to clean than rough surfaces, and wood cannot be sanitized. Keep in mind that even stainless steel surfaces can harbor pathogens if not cleaned and sanitized properly. A regular cleaning schedule must be developed utilizing appropriate cleaners and sanitizers. Standard operating procedures (SOPs), or detailed instructions, must be written and posted describing how and when the cleaning and sanitizing produces will take place.

Picking a sanitizer

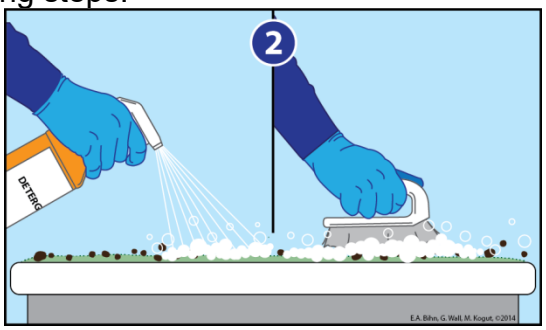
There are many sanitizers available on the market for use, including approved for organic use sanitizers. Options include chlorine, peroxyacetic acid, quaternary ammonium, hydrogen peroxide and others. Using too little of a sanitizer is ineffective, and too much of a sanitizer can cause damage to the surface you are cleaning. Consideration should be given to compatibility of the surface to be sanitized with the sanitizer. Incompatibility can reduce the effectiveness of the sanitizer and degrade the surface. This is also true for the detergent used to clean the surface. Label instructions should give guidance on what detergents are acceptable for the sanitizer. Be sure to read labels of the sanitizers, often available online, prior to purchase. Each sanitizer will have its own instructions for use, which can vary considerably. Visit the Cornell, Produce Safety Alliance Labelled Sanitizers for Produce Spreadsheet for up to date information and labels

https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fresources.producesafetyalliance.cornell.edu%2Fdocuments%2FPSA-Labeled-Sanitizers-for-Produce.xlsx&wdOrigin=BROWSELINK

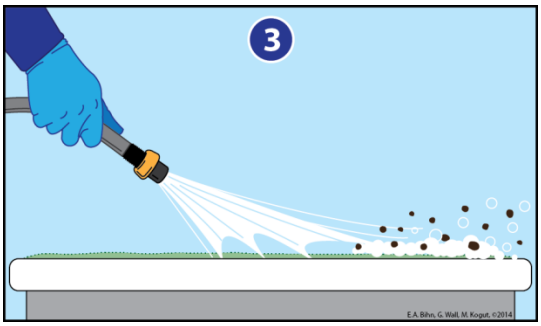
What is proper cleaning and sanitization of product contact surfaces?
Cleaning is the removal of dirt from surfaces which uses clean water and detergent. Sanitizing is the treatment of a cleaned surface to reduce or eliminate microorganisms. Dirty surfaces cannot be sanitized, the soil can render the sanitizer ineffective. Cleaning must take place before sanitization. Always use clean water that is free from generic *E. coli* for all cleaning and sanitizing steps.



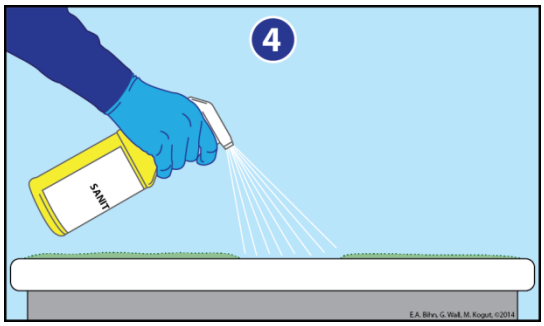
Step 1: Remove any obvious dirt and debris from the food contact surface.



Step 2: Apply an appropriate detergent and scrub the surface.



Step 3: Rinse the surface with clean water, making sure to remove all of the detergent and soil.



Step 4: Apply a sanitizer approved for use on food contact surfaces. Rinsing may be necessary Let the surface air dry.

Critical points to consider:

- Only use sanitizers that are approved for food contact surfaces, and follow the label directions exactly.
- Develop a regular cleaning schedule with a written SOP detailing the products used, how they are used, and the steps involved in cleaning and sanitizing the surfaces. Daily sanitizing is best!
- Utilize smooth surfaces that cannot absorb water as your product contact surfaces, wood can be covered with linoleum or painted with food grade paint.
- Avoid cracks and crevices in your packing areas, these are difficult to clean and sanitize.
- Train workers annually on Worker Health and Hygiene, including proper handwashing.
- Train workers annually on the importance of sanitation and the farms developed SOPs.

- Workers must wear clean clothing daily.
- When gloves are used workers must be trained on how to use them so they do not become a contamination source.
- Remove surface moisture in the packinghouse/area whenever possible using squeegees and fans.
- Remove culls from the packing area daily so they do not become an attractant for wildlife.
- Utilize a pest control program in the packing and storage areas, focusing on rodents and other wildlife intrusions.
- Remove as much soil as possible from produce in the field, not in the packing area.
- Use new containers or containers that can be cleaned and/or sanitized to pack and display produce.
- Storage areas and coolers should be monitored for cleanliness, and be included in the rodent control program.

Resources:

Introduction to Selecting an EPA-Labeled Sanitizer, Cornell Produce Safety Alliance. 2022. Introduction to Selecting an EPA-Labeled Sanitizer (cornell.edu)
Cleaning VS Sanitizing, Cornell Produce Safety Alliance. 2022. https://resources.producesafetyalliance.cornell.edu/documents/Cleaning-vs-Sanitizing.pdf
Small Scale Postharvest Handling Practices. University of California, Davis. 2003. http://ucce.ucdavis.edu/files/datastore/234-1450.pdf
*Photos curtesy of the Produce Safety Alliance